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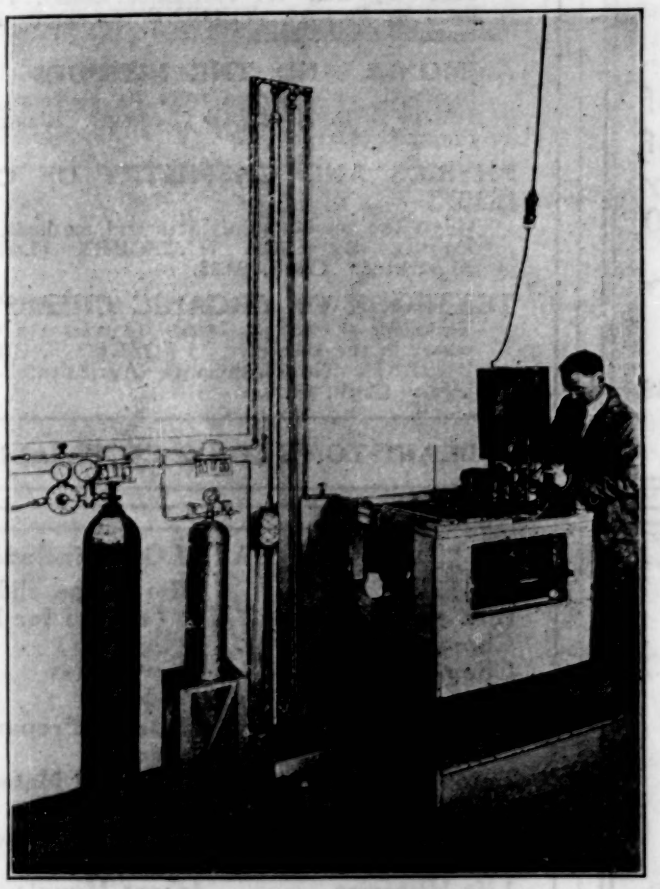

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THE HUMANIZING OF KNOWLEDGE[1]

I

ANY most familiar object will suddenly turn strange when we look it in the face. As we repeat some common word or regard keenly the features of an intimate friend they are no longer what we took them to be. Were it not for our almost unlimited capacity for taking things for granted we should realize that we are encompassed with countless mysteries which might oppress our hearts beyond endurance did not custom and incuriosity veil the depths of our careless ignorance. That I am "I" to myself and "you" to all of you, who are each of you "I" to yourself is on contemplation a perturbing circumstance. That the vibrations of my vocal cords should stir ideas in you is no easy matter to explain, and no one has yet been able to tell us why we and the earth so inerrantly attract one another. But these can hardly be called mysteries to most of our fellow men, who are so inured to personality, speech and weight that they are for them scarcely observed commonplaces.

Those to whom a commonplace appears to be most extraordinary are very rare, but they are very precious, since they and they alone have made our minds. It is they who have through hundreds of thousands of years gradually enriched human thought and widened the gap that separates man from his animal congeners. Without them the mind as we know it would never have come into existence. They are the creators of human intelligence. The mass of mankind must perforce wait for some specially wide-eyed individual to point out to them what they have hitherto accepted as a matter of

[1] Address before the American Association for the Advancement of Science, meeting in conjunction with the Pacific Division in Salt Lake City, June 23-24.

routine or failed altogether to notice. These mind-makers are the questioners and seers. We classify them roughly as poets, religious leaders, moralists, story-tellers, philosophers, theologians, artists, scientists, inventors. They all are discoverers and pointers-out. What eludes the attention of others catches theirs. They form the noble band of wonderers. Commonly unnoticed things excite a strange and compelling curiosity in them, and each new question sets them on a new quest. They see where others are blind, they hear where others are deaf. They point out profundities, complexities, involutions, analogies, differences and dependencies where everything had seemed as plain as a pike staff.

In short, poets, philosophers, religious geniuses, artists and scientists are all rare variants of the human species, who emerge here and there through the ages. Sometimes they make a wide appeal to their fellow men; often they stir their resentment or horror; most frequently they suffer neglect and contempt. A discovery to which no one listens is obviously of little or no importance. It is a mere private gratification which concerns only the discoverer himself. So the great question arises as to what determines the *success* of a new idea; what establishes its currency and gives it a social significance by securing its victory over ignorance and indifference or over older rival and conflicting beliefs?

To be accepted by the multitude of non-discoverers an idea must obviously be *attractive* to them in some way or other. And what are the kinds of attractiveness which promote the wide dissemination and the firm and prolonged acceptance of beliefs? This is a difficult question, and I do not flatter myself that I can answer it very satisfactorily. I take it that the new idea must seem "good," and mayhap noble, beautiful and useful, and that it must fit in pretty well with existing notions; or at least must not threaten violently to dislocate the accepted scheme of things. If it is ugly, wicked, discouraging, humiliating or seriously disturbing to the received plan of life it is likely to be shown the door. Ideas like kisses go by favor. The *truth* of the new idea proposed for acceptance plays an altogether secondary rôle. We rank the Good, True and Beautiful together but it is shocking to observe how little does the success of a new observation depend upon its scientific or historical credentials. In almost all we hear, read, say and come to believe, truth, in the scientific sense of the term, is a matter of almost complete indifference. It is irrelevant and may seem an impudent intruder and marplot. We often naïvely use the word "feel" for "believe," and even the word "believe" means to cling to something dear and precious, and good in our sight—to accept what we like to accept. And the wonder grows that there ever appeared in this world of ours a group of men like those here assembled so eccentric as to regard truth as the paramount issue.

If we make an exception of certain homely matters of fact which have underlain the development and practice of the industrial arts, mankind has until very recently been nurtured in the main on beliefs that were not submitted to any rigorous test of scientific or historical criticism, and which for the most part would not have been able to withstand careful scrutiny. But it would be a grave mistake to assume that what from a modern scientific standpoint are myths, poetic fancies and gross misapprehensions have not played an all-essential part in the building up of the human mind. Man's beliefs had inevitably in the first instance to be what suited him and what he naturally and easily grasped and clung to. For it is not the precise truth of an idea, as we have seen, that leads to its wide acceptance but its appeal; its congeniality to a being of the nature and setting of man. There had to be a vast widening of the primitive imagination and vocabulary, and innumerable guesses about real and imaginary things before a phenomenon so strange as modern science could emerge. Logical definition and speculation can operate quite as well—indeed better on unreal presuppositions than on experimentally verifiable ones.

Among the wonderers and pointers-out the poet, who "fancy light from Fancy caught," whose "thought leapt out to wed with thought," has always been surest of a large audience. For songs, heroic tales and rhapsodies can be attuned to the heart's desire—they are magic

carpets on which we can voyage whither we will. Their truth is the deepest truth, that of vague human longings. When we are told that Kubla Khan a stately pleasure dome decreed, "where Alph the sacred river ran, through caverns measureless to man, down to a sunless sea," we do not feel obliged to consult a list of Tartar rulers, or locate the sources of the river Alph, or consider the geological formation of limestone caverns. Few will be disturbed by the question of what particular species of wood louse secreted the honey dew, or the probable number of bacteria occurring per cubic centimeter in fresh milk of Paradise. When the scientific rumor reaches the poet that Nature is so careful of the type, so careless of the single life, he will find many who will share his impulse to kneel down upon "the great world's altar stairs that slope thro' darkness up to God." The truth of human fears, disappointments and aspirations is indeed the supreme truth, being made as we are, and is likely to remain so. All other truth no matter how true is in comparison dust and chaff, except for the few who owing to their highly exceptional temperament crave proofs and precision, at least in some narrow segment of life's circle.

Religion shares with poetry and romance the appeal to man's natural and deep longings and spontaneous inclinations. Indeed, among the many definitions of religion none is perhaps better than that of Santayana, to whom it seems to be poetry sometimes mistaking itself for science. Religion has concerned itself, at least during historic times, with those terrors, awes, obligations and aspirations which rest on a belief in supernatural beings, good and bad. It has to do with our vivid fears in a world of sad mischance; with the hopes, restraints and sacred duties which might in some way offset life's incalculable tragedies. The poetic elements in religion are accompanied by more or less definitely formulated beliefs about man's origin and nature and the workings of the things about him. These convictions are commonly of ancient and untraceable genesis, although they may finally be very logically and precisely stated by a Saint Thomas or a Calvin and form a part of a closely concatenated philosophical system. One may not, however, take the same liberties with religious beliefs as he may with the fancies of the poet. The adherents of a particular religious creed are not free to pick and choose, and reject what comes to seem improbable. The "truth" once delivered stands, for it depends largely on the form of its original delivery. It is the word of the Most High or of some prophet inspired by him. At least this has seemed inevitable to a great majority of Christians and their leaders since the founding of their faith. Religion therefore makes a double appeal, that of poetry and of divinely certified truth about all the great concerns of life. It meets questions about our origin, duty and possible fates, without any call for painful critical thinking, suspension of judgment and dubious, ever-to-be-revised, theories and hypotheses.

II

These preliminary reflections have been necessary in order to introduce the scientist to himself. He is quite as prone as others to take himself for granted and not realize what an altogether astonishing and even grotesque mystery he and his doings constitute. He, like the poets, philosophers, theologians and artists, belongs to the small and precious group of persistent wonderers. He is a questioner, a discoverer, a pointer-out. He like them gives meaning to things that would otherwise pass unnoticed. But there is something inhuman in his methods and aims. He craves a meticulous precision of observation, measurement and statement quite alien to the other teachers of men. He exhibits an almost shocking insensibility to the cherished motives of belief. He does not ask whether what he looks for is right or wrong, beautiful or ugly, useful or futile, comforting or distressing. He only asks whether what he finds is an instance of something really happening. He persistently carries his analysis as far as he can and scrupulously sets down just what he has seen and the inferences he may make or suspect. Moreover he interests himself in what appears to the overwhelming mass of mankind as stupid trifles which promise neither pleasure nor profit. What difference can it possibly make whether

a caterpillar has four muscles or four thousand, as described by the indefatigable Lyonnet; whether the light from metallic arcs may contain wave lengths as short as a six hundred thousandth of a millimeter; whether the solutions of the violet salt of chromium sulphate are stable at room temperature; whether there are sixty or eighty thousand species of beetles. And in other fields, what does it profit a man to be able to point out the interpellations in the Book of Ecclesiastes, or discover the origin of the Edict of Milan or describe the marriage customs of the small and obscure tribe of the Todi. And yet there can be no doubt that these and similar questions and their answers constitute the great bulk of scientific knowledge that has been accumulated during the past three centuries. They are stowed away in monographic contributions, proceedings and transactions under innumerable rubrics which no single man of science no matter how broad his interests and comprehensive his knowledge could possibly recall. This esoteric treasury of knowledge, the very existence of which is unknown, or indifferent, even to the so-called educated classes, is like a vast safety deposit vault with its many boxes large and small. The keys are in many hands, but few there be that can open more than two or three of the boxes.

Nevertheless the scientific investigator and the scholar has his own peculiar rewards. He finds a few like-minded persons to cooperate with him. Scientific research is not simply a solitary indulgence of infrequent and eccentric individuals. Little drops of knowledge coalesce into bigger drops, and odds and ends of detailed information gradually get shifted into patterns of great interest and beauty. For the world proves to be indefinitely investigable. Then there is much refreshingly human in the pursuit of knowledge. The investigator is the hero in a romance; he is keener than the sleuth of the detective tale and knows it. He has his territorial disputes, his ententes and his wars with his fellow scientists.

It is apparent however that the sustained and arduous scientific research which has gradually built up our fund of knowledge is a pursuit for the few. It is far from a seductive occupation for even creative minds of the poetic and religious type. It often requires years to ascertain facts and record observations that will in the end fill a small, abstruse and technical pamphlet. For research is mainly looking for things that are not there and attempting processes that will not occur. The layman has little notion of this. Experimental science is tireless fumbling and groping or, in its taxonomic aspects, the painful discrimination and comparison of detail. It is subject to innumerable disappointments in following trails that lead out into a boundless desert or up against barriers that it seems hopeless to try to scale. For the scientist does not make his own landscape as does the poet and even many philosophers, nor can he fly hither and thither at will, but he subjects himself to the tyranny of the natural phenomena or processes that he is observing, and, as Bacon says, he works "according to his stuff and is limited thereby."

The successs of modern scientific emulation lies very largely in its stubborn refusal to consider natural phenomena in terms of human impulse and mankind's native interests. During the Middle Ages the world was thought to be made for man. It was the vestibule to an eternal existence that awaited every human soul beyond the grave. As his transient sojourning place and scene of trial it had a moral and edifying quality which underlay a great part of the speculation about natural things. Around about the earth were the heavens, the ever perfect and incorruptible dwelling place of God and the angels and of the blessed who were found worthy to see His face. Those who began the reconstruction and further amplifying of knowledge, from the early seventeenth century onward, were on their guard against these older genial anthropomorphic and geocentric conceptions of Nature, and they also found various excuses for neglecting the sanctified interpretations prevailing in the universities. The preferences of the observer were to be ruled out. He was to be merely a careful and neutral spectator who must not allow himself to become so warmly implicated in his discoveries as to sacrifice a whit of his eager indifference. Of

course this proud isolation was subject to many compromises, conscious and unconscious. And from a philosophical standpoint the onlooker, as has often been pointed out, is always one of the essential elements in the observing and recording. The ideal was, however, and still is, to dehumanize scientific investigation so far as may be. And this method has approved itself by its exceeding fruitfulness.

III

The question here arises, how did this scientific ambition ever come to be a matter of public concern? How did this professedly idle curiosity, as Veblen ironically calls it, confined as it is to rare and eccentric intellects and affecting a superb indifference to human interests, ever come to influence the beliefs and daily lives of great masses of mankind? The indubitable and ever growing social significance of modern experimental science is the result chiefly of three historical tendencies.

1. In the first place the minute and scrupulous observations and calculations and careful inferences of the natural scientist have in a few cases formed themselves into such impressive generalizations as to catch the attention of laymen. Examples of such large reconstructions are the reduction of the celestial bodies to physical and chemical processes; a growing substitution of respect for so-called natural laws, and a corresponding decline of confidence in miracles and magic, the partial elimination of the diabolical in the theory and practice of medicine, and latterly the frank inclusion of man himself in the order of nature. This process of transforming a naturally unscientific creature into a scientific one has of course not gone very far, and the tendency has met with varied and insistent opposition with which we are all familiar.

2. In the second place the inventor and engineer have in the interest of practical utility seized upon certain details of scientific discovery and with the connivance of the business man, influenced by motives of pecuniary profit, succeeded in revolutionizing industry and intercommunication, thereby gravely altering the conditions, possibilities and problems of civilization. Scientific research originally carried on for its own sake has thus produced indirectly the most far-reaching effects on our daily life. Moreover the constant refinement of technology has led to the invention of scientific apparatus without which research could never have reached the point it has. A striking example of this is the perfecting of electrical apparatus which has recently rendered possible the discovery, bewildering in its implication, of the electrical nature of matter.

In the beginning mankind was in no position fundamentally and permanently to modify his environment in his own interests. He had to make such terms as he could with the uncontrolled order of nature. To-day through scientific knowledge and experiment he is constantly engaged in remaking the world to suit his convenience. He indeed often yields to the temptation to exploit his resources with a reckless abandon which raises many serious problems in regard to the future of the race. He substitutes mechanical devices for the human hand; he generates and distributes new forms of power, and has finally learned through synthetic chemistry to create an indefinite number of new substances. Achievements of this class are the most spectacular outcome of applied knowledge and have done more than anything else to secure the scientist a specious popular esteem. But the problem is becoming acute whether that esteem is of such a character that it will permit the overwhelming process of readjustment to be guided and controlled by those best qualified by natural competence and training to prevent varied catastrophe.

3. A third less theatrical but none the less significant effect of the progress of natural science has been the influence which its ideals and methods, so successfully applied to the investigation of physical, chemical and biological processes, has had on the conception of man himself, his origin, history, habits and institutions. Anthropology, history in all its branches, philosophy, psychology, economics, and all other departments of research bearing on man's nature and conduct are undergoing changes of a momentous nature so revolutionary in their theoretical and practical implications that some recent writers go so far as to maintain that a great part of what has passed for social science

is obsolete or obsolescent; that it will pass away in the light of new scientific knowledge even as the scholastic philosophy was supplanted by experimental science. Man suddenly finds himself a bewildered actor in a new drama where he must learn his part all over again on pain of disastrous failure in his appointed rôle.

To summarize the preceding reflections: Modern scientific research, in spite of its professed aloofness and disregard of human feelings and motives, has succeeded in unfolding to our gaze so new a world in its origin, development, workings and possibilities of control in the interests of human welfare that practically all of the older poetic and religious ideas have to be fundamentally revised or reinterpreted. Scientific knowledge ingeniously applied and utilized by inventors and engineers has, with the assistance of business men and financiers, metamorphosed our environment and our relations with our fellow men. Lastly, our notions of our own nature are being so altered that should we discreetly apply our increasing knowledge of the workings of the mind and the feelings a far more successful technique might finally emerge for the regulation of the emotions than any that has hitherto been suggested. This is at least an exhilarating hope.

Now if all this be true we are forced to ask whether it is safe when our life has come to be so profoundly affected by and dependent on scientific knowledge to permit the great mass of mankind and their leaders and teachers to continue to operate on the basis of presuppositions and prejudices which owe their respectability and currency to their great age and uncritical character, but which fail to correspond with real things and actual operations as they are coming to be understood. For a great part of our beliefs about man's nature, the rightness and wrongness of his acts date from a time when far less was known of the universe and far different were the conditions and problems of life from those of to-day. Do we not urgently need a new type of wonderer and pointer-out whose curiosity shall be excited by this strange and perturbing emergency in which we find ourselves and who shall set himself to discover and indicate to his busy and timid fellow creatures a possible way out? Otherwise how is a race so indifferent and even hostile to scientific and historical knowledge of the preciser sort—so susceptible to beliefs that make other and more potent appeals than truth—to be reconciled to stronger drafts of medicinal information which their disease demands but their palates reject?

IV

It is this paramount question that I had in mind in preparing this address. I have not the time nor indeed the capacity to make its multiform and urgent necessity clear as I should wish. But many of you, I know, have already been thinking of the matter and will concede the necessity and urgency without further argument. Others will have experienced a vague anxiety and foreboding about the present state and prospects of scientific advance, and what has been said may help to clear their minds if they do not agree forthwith that the present crisis is of the precise nature and gravity that it seems to me to be.

Much has been written of the conflict of science and religion. But this is to narrow down the real problem, which is nothing less than the stupendous task of cultivating an appreciation of the nature and significance of precise thought and exact knowledge in a being by nature and nurture so careless of truth and given to modes of thinking repugnant to scientific intelligence. For even the more magnificent scientific discoveries, especially those of recent years, have not penetrated into our general education and are entirely disregarded in most discussions of social problems. And yet an imposing accumulation of critical information of wide bearing is at our disposal which could become an active factor in the readjustment of the troubled relations of man were it possible to overcome the obstacles to its general dissemination and acceptance.

A striking illustration of the present ineffective methods of popularizing cardinal scientific discoveries has recently been supplied by the revival of a strong and threatening opposition to the knowledge we now have of man's affinity and obvious relationships with the rest of the organic world. The idea of organic

evolution is perhaps the most momentous in its bearings of all the great generalizations which have come with increased knowledge of the globe's history and the history of its inhabitants. Those who will take the trouble to consider even in the most elementary manner the multifold and concurrent evidence of the successive appearance of vegetable and animal species on the earth and the reasons for including man among the primates, can not fail, unless they be utterly blinded by prejudice, freely to concede the animalhood of man. The matter has been set forth by skillful writers such as Huxley, Wallace, Haeckel, John Fiske, Drummond and many others in a manner so plain and convincing that it would seem that no one would have the slightest inclination to take issue with them on the general proposition. But to judge from the conscious and unconscious confusion that seems to prevail in the minds of many the matter is still very ill-understood by even intelligent laymen.

Recently a serious misunderstanding has resulted from the report that men of science are giving up "Darwinism," that "Darwinism is dead." This has puzzled those who supposed that evolution was a well substantiated assumption, and has filled with a somewhat malicious joy those who have always denounced the notion as wicked and opposed to Scripture. To the public, Darwinism means evolution, man's monkey origin, as the matter is popularly but inexactly phrased. But to the paleontologist and biologist Darwinism does not mean the theory of man's animal descent, which was formulated long before the publication of the *Origin of Species,* but is confined to the ingenious theories which Darwin so patiently worked out to account for the facts of evolution. The statement that Darwinism is dead does not mean that the evidence for the evolutionary hypothesis has in any way been weakened or that any really competent man of science doubts our animal derivation. It only means that Darwin's explanations of how one species may have been derived from another have proved, as a result of increasing knowledge, to be mistaken or wholly inadequate. It means that we can not any longer assign the importance he did to sexual and natural selection and the hereditary transmissibility of acquired characters. But the confessed failure so far of biologists to clear up the process of evolution, or experimentally create a new species from an existing one, does not affect the facts derived from many converging sources which lead to the unavoidable conclusion that man has a genealogical relation to the higher animals.

It is the extraordinarily illuminating discovery of man's animalhood rather than evolution in general that troubles the routine mind. Many are willing to admit that it looks as if life had developed on the earth slowly, in successive stages; this they can regard as a merely curious fact and of no great moment if only man can be defended as an honorable exception. The fact that we have an animal body may also be conceded, but surely man must have a soul and a mind altogether distinctive and unique from the very beginning, bestowed upon him by the Creator and setting him off an immeasurable distance from any mere animal. But whatever may be the religious and poetic significance of this compromise it is becoming less and less tenable as a scientific and historic truth. The *facts* indicate that man's *mind* is quite as clearly of animal extraction as his *body*. Those older observations which are classed under paleontology, zoology, comparative anatomy, bio-chemistry, physiology and embryology, which reveal innumerable conformities and affinities between man and the higher mammals in structure, function and development from the egg, are now being paralleled by observations, classed under comparative psychology, functional psychology, anthropology, prehistoric archeology and intellectual history, which show that man's mind like his body is akin in its nature and fundamental operations to that of the higher animals.

The historical and comparative methods of approaching the study of the human body are largely responsible, as you are all aware, for our present rapidly growing understanding of it. The historical and comparative study of psychological phenomena—of what we call reasoning, emotions, impulses, the will—promise to be quite as clarifying and revolutionary when they can be freely applied. They will

alter the whole conception of the various old divisions of philosophy—logic, epistomology, psychology, ethics—and tend to put these hitherto rather unreal and half mythical disciplines on a firmer foundation of observable facts. To cite a single example of this hopeful tendency, John Dewey has recently issued a book called "Human Nature and Conduct" in which he frankly reverses the usual procedure of writers on ethics. He first takes up the nature and workings of the human animal and then attempts to deduce the general rules that would seem appropriate to a creature like man. Now, the moralists in the past have in general neglected man's nature, of which with their mistaken presuppositions they could at best know but little, and have devoted their attention to accepted standards of conduct, ancient and dubious in origin, which they sought to justify by subtle theories and ingenious applications. This was, of course, to do little more than to rationalize the prevailing morals and mores. Hence the general barrenness of ethics as commonly understood.

Those who follow the recent developments in philosophical speculation can not fail to see how deeply they are influenced by the methods and discoveries of natural science. Indeed this old distinction between "natural" science and our knowledge of man himself is an artificial and misleading one. Man is an integral part of the natural order; he and his environment are constantly interacting. Such well-tried old terms as the will, consciousness, selfishness, the instincts, etc., when reinspected in the light of our ancestral background and embryological beginnings, all look very different from what they once did. The soul is no longer the pale little creature, *Hospes comesque corporis,* as described in Emperor Hadrian's famous lines. Nor is the human body, made up as it appears to be, exclusively of electrical charges, so lumpish a thing as it seemed. Mind and matter can no longer be divorced but must be studied as different phases of a single vital and incredibly complicated situation. Mind, as a recent writer has well put it, is no longer to be viewed as "primary but eventual." It is in the making, and a historical consideration of human intelligence, taking into account its animal and prehistoric substrata, its development in historic times and the profound effect of childhood on adult thought and feeling, reveals all sorts of previously neglected elements in the estimate of mind itself and of its untold future possibilities.

V

The chief aim of education for us who really grasp the value of a scientific attitude and appreciate the inherent obstacles which oppose themselves to its successful cultivation in the human species should be the inculcation of the profoundest of truths, namely, that science is one. It is nothing more or less than the most accurate and best authenticated information that we possess, subject to constant rectification and amplification, of man's nature and history, and of the nature and history of the world in which he finds himself. It is just the most reliable knowledge we have. It is not history, philosophy, psychology, ethics, politics, economics; it is not astronomy, physics, chemistry, geology, botany, biology—these are merely historical divisions of labor, which are now being profitably transgressed as we learn more of the essential interweaving and mutual dependence of all things. Those consecrated divisions may still have a declining significance in research, but I can not but think that they are one of the chief barriers to the cultivation of a really scientific frame of mind in the young and the public at large. They are aspects of a single supreme theme, Man and his World. *Once it was well to dehumanize science; now it must be rehumanized.*

The prevailing misapprehension of the evolutionary or historical conception of life and its unity should not be permitted to afflict the coming generation. But the precautions necessary to prevent this, demand our most careful thought and planning. The problem is nothing less than so revising our education that a new type of mind will be cultivated appropriate to our present knowledge and circumstances. Education is, however, controlled to a large extent by those who still adhere to many ancient conceptions which appear to them to be based on the best wisdom of the past, to be tested by time and substantiated by a consensus of human experience. These they do not wish

to see disturbed. No two persons might agree as to exactly what these approved findings are, but so long as a notion is familiar it is assumed that it will not do any particular harm. Now, new knowledge, if taken seriously, is very likely to prove an indictment of those very ideas which are dearest to the ill-informed. So in order to avoid inconvenient discussion the doctrine has become popular that so-called 'controversial" matters should be carefully excluded from both the schools and colleges. This means, when stated in a bald form, that instruction which might stir religious prejudice, no matter how unintelligent, business, political or racial prejudice, or violate the proprieties, must be avoided. College presidents, school superintendents, text-book writers and their publishers are at present almost helpless in this situation. Teaching must be made as little disturbing as possible, when its chief function should be to stimulate thought and furnish new and reconstructive ideas. The plight of the directors of education is indeed pitiable. College presidents have to sit up late at night reconciling the noble doctrine of freedom of teaching with the practical necessity of dodging controversial questions—for at all costs nothing must happen to arouse the resentment of timid parents and donors. Like Milton, the college head can not endure the humiliating imputation that his teachers are under the wardship of an overweening fist; and yet he is constantly haunted by the nightmare of the fist which will refuse to write any more checks to the order of the institution if an instructor is carelessly charged with Bolshevism or with teachings tending to immorality, sedition or irreligion. And what is perhaps still worse the religious, moral or patriotic critics rarely take the trouble to find out what an instructor or text-book writer whom they attack really has said or believes. This scandalous state of affairs is too little understood. Those best informed about it are for various reasons disinclined to tell all they know. Those who plan out courses of study and write books for the schools are not free but must often make very humiliating terms with unintelligence.

Fifty years ago Matthew Arnold described education as "the getting to know on all matters which concern us the best which has been thought and said in the world; and through this knowledge turning a stream of fresh and free thought upon our stock notions and habits." This ideal would be accepted by most educators, but how very far are we from realizing it in practice. Teachers and text-book writers can not proceed directly toward this goal as they conceive it. They must hedge and suppress, compromise and extenuate, lest the authentic things now known which it concerns boys and girls to learn should unluckily start them thinking. For this might rouse the apprehension of some defender of the social and moral order, some professional patriot or some adherent of the Mosaic authorship of the Pentateuch. The politicians in the Kentucky legislature think themselves competent to decide whether the state should grant funds to any institution in which man's animal extraction is taught; the politicians in the New York legislature have provided that no one shall teach in the schools of the state who is known at any time to have expressed any distrust of our institutions.

Now nothing could be more diametrically opposed to the cultivation of a scientific frame of mind. Education should be largely devoted to the issues upon which the young as they grow up should be in a position to form an opinion. They should understand that scientific advance has greatly altered, and promises still further to alter, our environment, and our notions of ourselves and, consequently, the expediency of existing institutions of moral, social and industrial standards. We should have a dynamic education to fit a dynamic world. The world should not be presented to students as happily standardized but urgently demanding readjustment. How are they to be more intelligent than their predecessors if they are trained to an utterly unscientific confidence in ancient notions, let us say of race, heredity and sex, now being so fundamentally revised.

VI

Supposing it be conceded that one at least of the objects of a general education is to help the young to become acquainted with the best that is now known or guessed about mankind

and the world; that it concerns them to know this, and that it should be so presented that it will, by encouraging them to busy their minds with our stock notions and habits, best prepare them to lead more intelligent lives and deal more wisely than their predecessors with old and new problems. Would it not be a most important contribution to reorder and restate this knowledge and suggest its implications? Might not this be profitably done with entire disregard of the timidities of educators and the apprehensions of those who now support education? No doubt things would have to be said which have hitherto been regarded as dangerous or inappropriate for the young to know. Issues of a distinctly controversial nature would constantly be arising. So such a task should not be left to any single individual. College faculties and teachers' associations are in no position to run counter to respectable tradition, and few there be that have any disposition to do so. As I have thought over the matter I see no large and influential association so well fitted as yourselves through a peculiarly competent and broad-minded committee, to undertake the task of *humanizing science,* and setting a new standard of education. That it will be easy even with your resources to choose the very best persons for such a committee, or that its work will have any immediate effect on general education is probably too much to expect. There are, however, minds of the requisite temper, training and literary tact. They must be hunted out and brought together in an effective conspiracy to promote the diffusion of the best knowledge we have of man and his world. They should have been researchers at some period of their lives, and should continue to be researchers in another sense. Their efforts would not longer be confined to increasing knowledge in detail but in seeking to discover a new synthesis of what is already known or in the way to get known. They should be reassorters, selecters, combiners and illuminators. They should have a passion for diffusing, by divesting knowledge so far as possible of its abstract and professional character. At present there is a woeful ignorance even among persons who pass for intelligent, earnest and well read, in regard to highly important matters that are perfectly susceptible of clear general statement. The members of the proposed committee should combine a knowledge of the exigencies of scientific research with a philosophic outlook, human sympathy, and a species of missionary ardor. Each of them should have professional familiarity with some special field of knowledge, but this should have come to seem to him but a subordinate feature of the magnificent scientific landscape.

Such a committee should be freed from educational restraints and from all suspicion of having to consider the feelings and preferences of donors and financial supporters. The more open-minded teachers and managers of education, as well as text-book writers and their publishers, would welcome a tribunal of high standing and unimpeachable independence, whose opinion and decisions might be sought from time to time to offset the complaints of importunate critics, who are now a constant nuisance and occasionally a great danger. There is at present a growing discontent with our education which appears even among the hitherto docile student bodies. The trouble lies not so much in our sometimes inept and now and then tyrannical form of administration; nor is it to be met by devising new ways of teaching old things. We must look to the very core of the instruction given; to what is being taught and to what is not. There is a recognized failure to make connections between the work in school and college on the one hand and the obligations and amenities of later life on the other. The whole substance and content of our general education needs a thorough overhauling. Something should be found to replace the effete and disintegrating old arts course. A good and sound idea underlies it, but its aims and methods and assumed results will not stand inspection in the light of modern knowledge and modern conditions of life. The elective system was but a confession that the tree of knowledge had put forth so many and such thick branches that the trunk was no longer visible. The stately proportions of knowledge are now lost in its ramifications. This difficulty can only be met by a novel synthesis—groping and tentative at first, but which will at least recognize and

proclaim an essential need and suggest at least one way of meeting it.

At present there is no proper interplay between the so-called natural and social sciences; and each of these grand divisions of human knowledge, which belong so intimately together, dealing as they do with man and his world, are artificially separated by old boundary lines, defended against invaders and smugglers by jealous vested interests. This is an inevitable outcome of transplanting into our educational system the technical divisions of scientific research. It seems to me that our various scientific courses rarely produce either of the main results to be expected from them. They neither engender in the student a discriminating and exacting tendency of mind—that combination of open-mindedness and caution which should be the finest fruit of successful scientific training; nor do they foster such a lively understanding of the workings of nature that the fascination of ever discovering new wonders will endure through life and mitigate sorrow, boredom and disappointment. Of course, judged by this standard, the failure of education is no less conspicuous in the fields of literature, history, language and philosophy.

We need some new organized effort to bring together in an imaginative and novel manner the prevailing and sometimes conflicting knowledge of the material world, its fundamental nature as it is coming to be understood in the light of the astonishing new theories of matter itself; the general story of life, with some attention to the great classes of living creatures; the discoveries in regard to man's nature and functioning and the history of his achievements and perplexities.

To give a single instance of the way in which this might be done I will explain that a good many years ago I became bored with what passes for history and began to consider those things in the past that interested me. These proved to be such evidences as we have of how the beliefs we now accept about man and his world grew up and developed. I found myself a trespasser roaming about in the preserves of the philosopher, theologian, anthropologist, comparative psychologist, prehistoric archeologist and of the historians both of literature and science—to mention only a few of my divagations. Now this has proved very amusing and instructive to me, and I have found many hundreds of young men and women to follow me in my wanderings. When we got through we had discovered a new world, and man's past and the possibilities of his future were no longer what we had taken them to be. What I have done others can do in better and more ingenious ways; and the history of man's achievements and growing understanding of himself and his world could be made a branch of study beginning early and running through all the years of school and college. For, as Francis Bacon said, the history of the world without the story of man's education is like a figure of the mighty giant Polyphemus with his single great eye left out.

An Association for the Advancement of Science representing theoretical knowledge and some of its multiform practical applications, should not confine itself merely to forwarding the progress of research; coordinating, systematizing and applying the discoveries made. It must assume the further responsibility, in the juncture in which mankind now finds itself, of cultivating and spreading an appreciation of our best knowledge of man and his world among those now indifferent or actively hostile to it. We have every reason to dread unintelligence, but are as yet altogether too considerate of the unintelligent; for we know that they usually have the whip hand. How shall we escape from this unworthy bondage?

I am aware that the new organization at Washington under the auspices of this association, Science Service, is already doing what it can to spread the knowledge of new discoveries and keep the public *au courant* of scientific advance. I know that the admirably edited periodicals, SCIENCE and THE SCIENTIFIC MONTHLY, are performing the same service for those sufficiently prepared to read them with interest and understanding. But excellent as is this beginning we must prepare to go much farther by making scientific knowledge in the broadest sense an integral part of education from beginning to end. We must so identify it with the experience of the child and the youth that no longer will a deeper import lurk in

the legends told us in our infant years than in "the truth we live to learn."

JAMES HARVEY ROBINSON
NEW SCHOOL FOR SOCIAL RESEARCH

THE FOOD RESEARCH INSTITUTE OF STANFORD UNIVERSITY

THE Food Research Institute of Stanford University was founded in February, 1921, by the Carnegie Corporation of New York in conjunction with the trustees of Leland Stanford Junior University, California. It is organized for the purpose of intensive scientific study of the problems of the production, distribution, and consumption of food. The institute grew out of a suggestion offered by Mr. Herbert Hoover, and its location at Stanford University was due partly to the fact that this university possesses, in the Hoover War Library, a large and unique collection of documentary material relating to the food problems and other economic aspects of the Great War. The Carnegie Corporation guarantees stated funds for the work for a period of ten years. Stanford University provides quarters and facilities and has appointed the directors of the institute to positions on the Stanford faculty.

The control of its policies and the active direction of the work of the institute are entrusted to three joint directors. The plan of the founders called for the selection of an expert in agriculture and food manufacture, an expert in economics and food distribution, and an expert in the physiology and chemistry of nutrition. In accordance with this plan, the following directors were appointed in April, 1921: Carl L. Alsberg, M.D., Joseph S. Davis, Ph.D., and Alonzo E. Taylor, M.D. At the same time an advisory committee was appointed comprising the presidents of Carnegie Corporation and Stanford University, *ex officio,* and the following additional members: Hon. Herbert Hoover, secretary of commerce; Dr. James C. Merriam, president of the Carnegie Institution of Washington; Mr. Julius Barnes, formerly president of the U. S. Grain Corporation; Dr. William M. Jardine, president of the Kansas State Agricultural College; Mr. J. R. Howard, president of the American Farm Bureau Federation; and Mr. George Roeding, formerly of the California Horticultural Commission.

The founding of the Food Research Institute is an outgrowth of war experience. During the late war, possibly for the first time in history, food production and distribution, nutrition and dietetics had to be considered by governments as national and even international problems. In determining policies required to meet the emergency, food administrators sought certain scientific information, from agriculturists, economists, physiologists, and physicians. Many valuable data were readily furnished. On the other hand, much of the desired information was not in existence, not because, given time, it would have been difficult to obtain, but because no one before the war had asked these questions or attempted to reach an adequate answer. Nutrition and dietetics had been studied mainly as individual problems, not as mass problems. The food supply had seldom been examined with adequate reference to its international aspects and to the particular commodities entering into it. Marketing problems had received mainly local investigation. There had been little coordination of studies in several important fields, and serious gaps were numerous. In many instances, therefore, the lack of essential information led to action more or less in the dark.

The founders of the Food Research Institute were convinced that the scientific study of such problems, from a broad national and international viewpoint, was important in peace no less than in war. While recognizing the essential services which research work in federal and state agricultural departments and colleges had rendered and will continue to render, they considered that a non-governmental organization with university affiliations could have advantages in attacking certain kinds of problems without the limitations which apply to these agencies.

The institute proposes, therefore, to investigate significant food problems from the standpoint of their bearing upon national economy and well-being, to deal with them as mass problems, and to emphasize the commodity and

international aspects. While it will frequently study data of individual businesses, it will do this not in order to serve as a business adviser, but primarily in order to discover principles of general importance.

The precise program of the institute will be developed gradually. Its exact form will be determined partly by the readiness with which essential data on particular subjects can be assembled, and by the work which is already in progress elsewhere. In the course of its activity the institute will concern itself with such subjects as the food elements in actual and normal standards of living, and the physiological and social aspects of sub-nutrition; the sources, production, marketing, and utilization of important staple foodstuffs, such as wheat; the financing of farm operations and the manufacture and marketing of food products; the analysis of important food industries and the problems which they present; the technology of food manufacture, and the desirable scope of public control thereof; and the elements in a sound national policy with respect to food production, internal distribution, and international trade.

Numerous existing organizations are already conducting research into food problems, from one angle or another, notably the Department of Agriculture, state bureaus of markets, agricultural colleges and experiment stations; research organizations of banks, business houses, trade and marketing associations; and university departments, committees, or individuals. It will be the policy of the institute to avoid, so far as possible, any serious overlapping of the work of established research organizations, public or private. It will endeavor rather to enlist the aid of existing organizations in the prosecution of researches in which there is a common interest, in which essential data are already collected or in process of collection, or in which another organization is in a better position to perform a portion of the research. Moreover, in numerous instances the institute will consider its purpose accomplished if methods which it may develop, or sample studies which it may make, can be utilized by public or private agencies in undertaking similar investigations on a far more extended scale.

The research work will be done, for the most part, at Stanford University. In general, subjects for investigation will be selected which do not necessitate extensive field work, or in which the results of field investigations conducted by other competent organizations can be utilized. It is recognized, however, that certain investigations which the institute can undertake will require more or less field work by the directors, fellows, or assistants, and for these necessary provision will be made.

The institute is organized as an integral part of Stanford University, with the status of a department for the purpose of directing research and recommending degrees. For the year 1922-23 it has established four fellowships for graduate study in the field of food research. The directors will guide the work of these fellows, and occasionally a few other well-qualified graduate students, in studies which fall within the scope outlined above and which will frequently constitute a specific part of a piece of research which the institute has in process. Such individual research will ordinarily form a part of the work toward a higher degree at Stanford University, and will be supplemented by such work in other departments of the university as may be necessary to fulfill the usual requirements for degrees.

While the institute does not contemplate undertaking extensive experimental work on its own account, the university's established facilities for experimental research on foods, nutrition, etc., are available to graduate students, and to a limited extent the directors of the institute will cooperate in the direction of research in these fields. In addition, the directors will occasionally offer courses of instruction in other deparments of the university.

In part the results of researches will be published through established technical journals. Where circumstances render this undesirable, the results will usually appear in a series of publications to be issued by the Food Research Institute. In cases where certain lines of research are of interest to specific groups of readers, other or additional channels of publication will be sought in order to reach those concerned.

The first year of the institute has been

largely occupied with the establishment at Stanford, the determination of general policies, the organization of a small staff, enlarging the collection of data which will be required for research, and making certain preliminary surveys and investigations designed to furnish the basis for more intensive studies. The work will be fully under way by the autumn of 1922.

SCIENTIFIC EVENTS

CANADIAN SOCIETY OF TECHNICAL AGRICULTURISTS

THE Canadian Society of Technical Agriculturists held its second annual convention at Macdonald College, Ste. Anne de Bellevue, Que., in the week of June 26 to July 1. In addition to the business sessions, a number of advanced lectures were given, the expense of which was borne by the Dominion Department of Agriculture. Professors W. T. Jackman, of the University of Toronto, and A. Leitch, of the Ontario Agricultural College, discussed topics appertaining to rural economics. Professor L. J. Cole, of the University of Wisconsin, spoke on "Genetics"; Dr. A. Bruce Macallum, of the Synthetic Drug Company, Toronto, on "Vitamins"; and Dr. M. O. Malte, National Herbarium, Ottawa, and Professor R. G. Stapledon, director of the Plant Breeding Station, Aberystwyth, Wales, on "Plant Breeding." President L. S. Klinck, of the University of British Columbia, delivered the presidential address and was succeeded in the chair by President J. B. Reynolds, of the Ontario Agricultural College. An interesting feature of the convention was an excursion to the Oka Agricultural Institute, La Trappe, Que., where the members of the society were very hospitably entertained by the staff of the institute under the Reverend Father Leopold. Speakers at the luncheons and banquets included the Honorable J. E. Caron, minister of agriculture, Quebec; Dr. J. H. Grisdale, federal deputy minister of agriculture; Dr. Jas. W. Robertson, Ottawa; the Reverend Father Leopold, principal of the Oka Agricultural Institute, and Principal F. C. Harrison, of Macdonald College. Professor W. H. Brittain, of the Nova Scotia Agricultural Society, was appointed representative of the society on the council of the American Association for the Advancement of Science. The society maintains a Bureau of Records of its members, which serves as an employment agency, and a bilingual journal, *Scientific Agriculture* (*La Revue Agronomique Canadienne*), both of which are conducted by the general secretary-treasurer, Mr. F. H. Grindley, B.S.A., Gardenvale, Que.

BISHOP MUSEUM FELLOWSHIPS

FROM the list of applicants for the Bishop Museum fellowships Yale University announces the selection of the following fellows for the year 1922-23:

Henry W. Fowler, ichthyologist, Philadelphia Academy of Science.

N. E. A. Hinds, instructor in geology, Harvard University.

Carl Skottsberg, director of the Botanical Garden, Gotenberg, Sweden.

Dr. Fowler will devote his attention to a study of the fish of Hawaiian waters; Dr. Hinds will continue his investigations of the geology of the island of Kauai; Dr. Skottsberg plans to make a study of the flora of Hawaii with particular reference to comparison with the plant life of Juan Fernandez and other islands of the southeast Pacific.

The four Bishop Museum fellowships yielding $1,000 each were established in 1920 by a cooperative agreement between Yale University and the Bernice P. Bishop Museum of Honolulu. They are designed primarily for aid in research on problems in ethnology and natural history which involve field studies in the Pacific region.

The Bishop Museum fellows for 1921-22 were Dr. F. L. Stevens, professor of botany in the University of Illinois; Dr. Stephen S. Visher, professor of geography in the University of Indiana, and Ruth H. Greiner, graduate student in ethnology in the University of California. The results of Professor Stevens' work on Hawaiian fungi and of Miss Greiner's study of Polynesian art have been submitted to Bishop Museum for publication.

THE HULL MEETING OF THE BRITISH ASSOCIATION

THE association meets from September 6 to 13 under the presidency of Sir C. S. Sherrington, Waynflete professor of physiology at Oxford, who will succeed Sir Edward Thorpe.

The London *Times* states that the presidential address will be on "Some aspects of animal mechanism." In the course of the meeting there will also be two evening discourses, the first by Professor W. Garstang on "Fishing: old ways and new," and the second, which will raise a question that created great interest at the last meeting in Edinburgh, by Dr. F. W. Aston, F.R.S., on "The atoms of matter: their size, number and construction." An interesting part of the proceedings will be the series of Citizens' Lectures, in development of the movement started by Huxley in the "sixties." These lectures will be four in number. Dr. E. H. Griffiths, F.R.S., will speak on "The conservation and dissipation of energy," Sir Westcott Abell, of Lloyd's Register, on the "Story of the ship"; Dr. Smith Woodward, of the Natural History Museum, on the "Ancestors of man"; and Professor A. P. Coleman, Toronto, on "Labrador." There will also be special lectures for children, at which Professor H. H. Turner, F.R.S., will speak on "The telescope and what it tells us," Professor J. Arthur Thomson on "Creatures of the sea," and Mr. F. Debenham on "The Antarctic."

Since the program was first arranged Dr. W. H. R. Rivers, F.R.S., president-elect of the Psychology Section, who was to have spoken on "The herd instinct and human society," has died, and his place will be taken by Dr. C. S. Myers, F.R.S., who will speak on the influence of the late Dr. Rivers on the development of psychology in Great Britain. The following are the titles of the other addresses to be given by sectional presidents:

Mathematics and Physics: Professor G. H. Hardy, F.R.S., "The theory of numbers."

Chemistry: Principal J. C. Irvine, F.R.S., "Research problems in the sugar group."

Geology: Professor P. F. Kendall, "The physical geography of the coal swamps."

Zoology: Dr. E. J. Allen, F.R.S., "The progression of life in the sea."

Geography: Dr. Marion Newbigin, "Human geography: first principles and some applications."

Economics: Professor F. Y. Edgeworth, "Equal pay to men and women for equal work."

Engineering: Professor T. Hudson Beare, "Railway problems in Australia."

Anthropology: Mr. H. J. E. Peake, "The study of man."

Physiology: Professor E. P. Cathcart, F.R.S., "The efficiency of man and the factors which influence it."

Botany: Professor H. H. Dixon, F.R.S., "The transport of organic substances in plants."

Education: Sir R. Gregory, "Educational and school science."

Agriculture: Lord Bledisloe, "The proper position of the landowner in relation to the agricultural industry."

The special interest of Hull as a fishing center will receive prominent attention in a series of sectional discussions dealing with the North Sea. On the more technical side, a discussion of intense interest will be that on "The origin of magnetism," which will be opened by Professor P. Langevin, Paris, and in which Professor P. Weiss, Strasbourg, will also take part. Another subject to be discussed is that "Economic periodicity," which arises out of the theory expressed by Sir William Beveridge that there is a bad time coming in a few years. Lord Haldane will lecture on "The ideal of our national education," and, among the other topics which will be dealt with are "Training in citizenship," "Psycho-analysis and the school," "Vitamins," "The present position of Darwinism," "The possibility of increasing the food supply of Great Britain," and "Our bones and teeth" (the latter, a lecture by Professor W. D. Halliburton, F.R.S.).

A special effort is being made this year to attract the younger generation of students. Thanks to the beneficent gift of £10,000 of War Stock recently handed over to the association by Sir Charles A. Parsons, the association has offered a certain number of exhibitions to universities and university colleges in Great Britain.

SCIENTIFIC NOTES AND NEWS

PROFESSOR EDWARD SYLVESTER MORSE, of the Peabody Museum of Salem, Massachusetts, and the Boston Museum of Fine Arts, an authority on Japan and the Nipponese people, their habits, customs and arts, was in 1898 decorated by the Japanese government with the Order of the Rising Sun. He has now received through the Imperial University of Tokio, from the department of foreign affairs, Japan, the second class of the Order of the Sacred Treasure, "in recognition of meritorious services rendered to the cause of learning and culture" in Japan.

A COMPLIMENTARY dinner was tendered to Professor and Mrs. G. F. Hull, of Dartmouth College, on July 15, by the departments of physics, astronomy and physiological optics, in celebration of the twenty-fifth anniversary of Professor Hull's doctorate. Professor Hull received the degree of Ph.D. from the University of Chicago on July 1, 1897. Later the party was entertained at the home of Professor and Mrs. A. B. Meservey. Congratulatory letters were read from Dr. E. F. Nichols, formerly of the department of physics of Dartmouth, from Sir J. J. Thomson, of Trinity College, Cambridge, with whom Professor Hull has studied, and from others with whom he has been associated.

A COMPLIMENTARY dinner was recently given to Dr. Henry Head, F.R.S., on his retirement, in recognition of his services as editor of *Brain* for seventeen years. The chair was taken by Sir Charles Sherrington, F.R.S., professor of physiology at the University of Oxford and president of the Royal Society and of the British Association.

THE James Scott Prize of the Royal Society of Edinburgh, established in 1918 for a lecture or essay on the fundamental concepts of natural philosophy, was presented on June 5 to Professor A. N. Whitehead for his lecture entitled "The Relatedness of Nature."

HONORARY degrees have been conferred by the University of Sheffield on Sir Charles Parsons for his work on the turbine engine, and on Mr. T. W. Hall for researches in paleography and archeology.

M. AMÉ PICTET, professor of chemistry at the University of Geneva, has been elected a corresponding member by the French Academy of Sciences.

PROFESSOR GEORGE H. F. NUTTALL, of the University of Cambridge, has been elected a corresponding member of the Société de Biologie, Paris, and of the Society of American Bacteriologists.

THE Swedish Medical Association at a recent meeting voted to commemorate the sixtieth birthday of Professor A. Gullstrand, in June, with a special gold medal and the foundation of a fund in his honor. He was given the Nobel prize in medicine in 1911 for his contributions to the science of ophthalmology.

PROFESSOR T. PETRINA, of Prague, professor emeritus of internal diseases and president of the German section of the Bohemian Medical Society, retired from this and other positions on reaching his eightieth birthday recently. The German-Bohemian members of the society have founded the Petrina Endowment in his honor.

MR. V. H. GOTTSCHALK, of the technical branch of the Western Electric Company, at Hawthorne, Ill., has joined the research staff of the Society of Automotive Engineers, New York City.

THE following men have accepted temporary appointments at the Japanese Beetle Laboratory, Riverton, N. J., for this summer and have reported for duty: Professor W. A. Price, of Purdue University; Dr. Henry Fox, of Mercer University; H. H. Pratt, a graduate of Rutgers College, and J. H. Painter, a graduate of the University of Maryland. There was received at the Japanese Beetle Laboratory earlier in the spring what is believed to have been one of the largest shipments of imported parasite material ever brought into this country from abroad. Something over a hundred thousand cocoons of a tachinid known to be parasitic on the Japanese beetle in Japan were sent to the laboratory by C. P. Clausen and J. L. King, who are stationed in Japan and working upon Japanese beetle parasites there. A fairly large proportion of these cocoons

were apparently in good condition upon their arrival at the laboratory and emergence has just commenced.

THE British Commissioners of 1851 announce the following appointments to science research scholarships (overseas):

Canada: J. M. Luck, University of Toronto, biology; W. H. McCurdy, Dalhousie University, physics; D. F. Stedman, University of British Columbia, physical chemistry.

Australia: Miss M. Bentivoglio, University of Sydney, crystallography; J. S. Rogers, University of Melbourne, physics.

New Zealand: J. C. Smith, University of New Zealand, chemistry.

South Africa: I. Low, University of Stellenbosch, meteorology.

DR. T. T. READ, chief of the information service of the United States Bureau of Mines, has been appointed by the president of the American Institute of Mining and Metallurgical Engineers as the official representative of the institute to attend the International Congress of Engineering to be held in Rio de Janeiro, Brazil, in September. Dr. Read expects to leave for Rio de Janeiro about August 15.

DR. A. B. STOUT, of the New York Botanical Garden, will be in residence as professor at Pomona College during the year 1922-23, being on leave of absence for one year.

A PARTY in charge of Dr. C. H. Edmondson and Dr. Stanley C. Ball, of the Bishop Museum staff, sailed on July 10 for Fanning Island. They plan to make a study of the bird life and marine fauna and to procure representative collections.

PROFESSOR ARTHUR JOHN HOPKINS, of the department of chemistry of Amherst College, has started on a tour of eleven months through Spain, Italy and Egypt. He will search for traces of alchemy.

DR. W. B. CANNON, professor of physiology at the Harvard Medical School, gave a Mayo Foundation lecture at the Mayo Clinic on June 20. His subject was "The effects of the emotions on the body."

J. D. SISLER, of the Pennsylvania Geological Survey, is spending the summer mapping the geology of the Myersdale quadrangle in the southwestern part of the state, and M. E. Johnson visited the Tidioute oil pool in the northwest part of the state a few days ago and will shortly resume geologic mapping of the Pittsburgh quadrangle.

THE name of Dr. Keating Hart, who lived in Paris, is gazetted in the *Journal Officiel* on June 16 as having "deserved well of France and humanity." The order points out that he had specialized for twenty-five years in electrical and X-ray therapy, and had rendered great service in research work. During the war he showed the utmost contempt of danger while attending to the wounded under bombardment. Injured by exposure to X-rays he underwent two operations on his right hand, but nevertheless he continued his work until his death on January 25 of this year.

THE French Senate has unanimously voted 2,000,000 francs to observe the hundredth anniversary of the birth of Louis Pasteur, which will take place this year. The Senate in voting the appropriation described Pasteur as the "symbol of French science."

MORIZ WEINRICH, sugar expert, well-known in the beet, cane and refining industry throughout the world, died on July 15 in Rosendale, New York, after a brief illness, at the age of seventy-six years.

MR. ERNEST WILLIAM LYONS HOLT, chief inspector of Irish fisheries, died on June 10, at the age of fifty-seven years.

DR. JACQUES BERTILLON, who had charge of the bureau of statistics at Paris, in which position his father and grandfather had preceded him, has died at the age of seventy-five years.

A RECENT exploration of Palmyra Island, lying about 1,000 miles south of Hawaii, has resulted in a map and a large collection of zoological material, especially mollusca and crustacea, which go to enrich the collections of the Bishop Museum.

IT is announced by Professor E. Perroncito, president of the Second International Congress of Comparative Pathology, that this congress, which was to have convened at Rome on September 20, 1922, has been postponed until

sometime in 1923. The date will be given in later announcements.

THE Congress of the German Society of Geneticists will be held from September 25 to 27, immediately after the Mendel celebration in Brünn. It is open to members, as well as to guests interested in research in genetics. The following addresses are on the program and will be followed by a general discussion of the subjects: R. Goldschmidt, Berlin, "The problem of mutation"; H. Spemann, Freiburg i. B., "The hereditary material and its activation"; E. Rüdin, Munich, "The inheritance of mental disturbances." On September 27 a special session will be held, which will be addressed by E. Baur, Berlin, on the "Tasks and aims of the science of genetics in theory and practice." In addition to these addresses, a large number of other papers are on the program. Information on all matters concerning the congress and its program may be obtained from Dr. H. Nachtsheim, Berlin, N. W., Invalidenstrasse, Nr. 42.

A MEETING was held recently at Harvard University, at which the subject under discussion was the killing of flies and mosquitoes. Sanitary experts, business men and the heads of women's and children's welfare organizations of the metropolitan district were present. J. Albert C. Nyhen, director of fly and mosquito suppression of the Brookline Board of Health, and Professor G. C. Whipple, of the engineering department of Harvard University, called the meeting, at which Professor Whipple presided. Its purposes were to consider action to be taken in a cooperative movement for the suppression of mosquitoes and flies in the metropolitan area and to call a later meeting to start a state-wide mosquito campaign. It is hoped that all insect nuisances affecting public health may be abolished and the movement will try to include the flea and the biting fly.

THE Forest Service of the United States Department of Agriculture is using airplanes for locating and photographing undiscovered lakes in the national forests of Alaska. It has long been known that there are many lakes on the headlands and islands traversed by the inside passage between Seattle and Skagway that do not appear on any map. During the New York-Nome flight made by army aviators, lakes were frequently sighted which could not be found on the latest and most authentic maps of the territory. Tales of unknown water bodies are constantly being brought in by trappers and prospectors. Less than a year ago a lake four and one half miles long and one half mile wide was discovered at the head of Short Bay. This lake has over 1,000 acres of surface area and is less than one and one fourth miles from tidewater, yet because of the surrounding country's rough topography, it has remained unknown and unnamed. Recognizing that many other of these "lost lakes" may be sources of valuable water power, the Forest Service has laid plans to map this no man's land of the north by means of aerial photographs. A few days' flight, it is said, will be sufficient to cover the area with a degree of accuracy that would require many years and great expense to accomplish by ordinary methods. The work, which has been approved by the Federal Power Commission, will be done by seaplane, flying from Ketchikan as a base.

THE *British Medical Journal* states that the annual report of the Gordon Memorial College at Khartoum for 1920, which is the nineteenth, shows steady progress in all directions; it pays a tribute to the late Sir William Mather, one of its most generous supporters and an energetic member of the governing body for seventeen years. The Wellcome Research Laboratories are accommodated in the Gordon Memorial College; they are under the supervision of Major Archibald, who is maintaining the high standard set by his predecessors, Drs. Andrew Balfour and Chalmers; it contains research departments in medicine, chemistry and entomology, the activities of which are duly set forth. Research work in the bacteriological section was interfered with by depletion of the staff and by the large amount of routine work that had to be carried out. But the director has a number of articles awaiting publication—namely, notes on urinary amœbiasis in the Sudan; on kala-azar in the Sudan; on tropical splenomegaly caused by a hitherto undescribed bacillus; on

juxta-articular nodes, their etiology and pathology; and on baciluria as a cause of pyrexias of uncertain origin in the tropics. According to the report, the time when the prophets of research had to clamor for a hearing is happily past, and there is no longer any hesitation on the part of government departments or private enterprise in appealing for assistance. Of the two possible methods of extension to meet these increased responsibilites Major Archibald advocates decentralization, by the establishment in various parts of the Sudan of local laboratories, temporary or permanent, for medical, chemical, and entomological research. This he considers preferable to the creation of new and larger laboratories at Khartoum. His recommendation has been unhesitatingly approved by the government.

IN order to present to the public more promptly the results of its scientific investigations, the Bureau of Mines issues a series of brief mimeographed reports of investigations as an adjunct to the printed publications. Besides affording a medium of prompt publication of information, the reports of investigations provide a vehicle for the publication of briefer material which would hardly justify issuance in the form of printed bulletins. These reports deal with major metals, minor and rare metals, non-metallic minerals, petroleum, gasoline, coal, coke, safety, sanitation, mine accidents and other subjects. The reports are mailed free to interested applicants as long as the editions are available. Descriptive notices of issues in the series are mailed regularly to all who desire to receive the information. Serial 2316, just issued, is a subject list of reports of investigations issued to December 31, 1921, and describes some 300 reports, whose range covers such subjects as abrasives, automobile exhaust gases, breathing apparatus, carbon black, Fuller's earth, liquid oxygen explosives, mine telephones, oil pipe lines, slate dust, valuation of oil properties, airplanes in mine-rescue work, powdered coal, helium, mine timbers, lead poisoning, smoke prevention, clays, building stones, safety in quarrying, etc. Serial 2316 may be obtained from the Bureau of Mines, Washington, D. C.

The *Journal* of the Royal Geographical Society reports that a short account is given in *Ymer* of the scientific expedition organized by Prince William of Sweden for zoological research in the region of the Kirunga volcanoes, north of Lake Kivu. The expedition left Marseilles towards the end of 1920, landed at Mombasa, and passed through the Kenya colony and Uganda to its destination. Various camps were established among the volcanoes and on the north shore of the lake, and extensive zoological collections made, including specimens of the mountain gorilla. Near the lake the barren lava-fields due to the sudden eruption of a new volcano in December, 1912, were found to be but sparsely covered here and there by new vegetation. The expedition went north to the Belgian post of Ruchuru and Lake Edward, through a district described as a paradise for sportsmen. Passing rapidly through the Semliki valley, where interesting collections were made in the outliers of the great equatorial forest, it spent some time at the Belgian post of Isumu, and made some study of the Wambutti dwarfs. Thence the return was made by Lake Albert and the Nile. The collections, which have been deposited at the Natural History Museum at Stockholm, include about 1,000 mammals, 1,700 birds, and some hundreds of reptiles and amphibia, besides a large number of insects.

UNIVERSITY AND EDUCATIONAL NOTES

SIX medical students from Polish universities have been selected to go to America to finish their studies preparatory to entering the new Institute of Hygiene recently established at Warsaw by the Rockefeller Foundation. Professor Selskar Gunn, representing the Rockefeller interests, has made the final choice of the students after a competitive examination organized by the Polish ministry of health. An endowment of $250,000 has been given for the establishment of the institute by the Rockefeller Foundation.

THE departments of engineering and medicine at the Kyushu Imperial University have just been opened to women students. Women are still barred from attendance at the Imperial University in Tokio and at most of the other higher schools.

AT Stanford University, Dr. Lewis M. Terman has been appointed head of the department of psychology to succeed Professor Frank Angell, who retired at the end of the academic year 1921-1922. Other additions to the department include Dr. W. R. Miles, professor of psychology, and Dr. Calvin P. Stone, assistant professor.

PROFESSOR J. J. THORNBER, director of the Arizona Agricultural Experiment Station, has in addition received appointment as dean of the College of Agriculture of the University of Arizona, succeeding Dean D. W. Working.

MR. CHARLES W. T. PENLAND, A.M., Harvard, has been appointed instructor in biology in Colorado College for the ensuing year. Mr. H. R. Remmers, A.M., Iowa, has been appointed instructor in psychology.

MR. R. A. BRINK, who has for the past two years been at the Bussey Institution of Harvard University, has been appointed assistant professor of genetics at the University of Wisconsin. He succeeds in this position Dr. E. W. Lindstrom, who goes about September 1 to the Iowa State College at Ames as professor of genetics, where he will organize a new department.

DISCUSSION AND CORRESPONDENCE

FILTERED AIR

IN SCIENCE of June 2, 1922, in mentioning the work of the Committee for the Investigation of Atmospheric Pollution, reference was made to the work of Dr. Owens on the amount of dust found in expired air. It has been taken for granted, I think, by many medical men that in passing through the nasal and buccal passages efficient filtering of the air took place; and that all dust particles were deposited on moist membranes and automatically removed by secretion flow. Dr. Owens' experiments seem to prove that in ordinary breathing the expired air still contained as much as 70 per cent. of the suspended impurities which entered during inspiration. So that only about 30 per cent. of the impurities in air are removed in transit through respiratory passages.

Dr. Chase S. Osborn, formerly governor of Michigan and one who had much to do with mines, referring to the above mentioned insufficient filtering, suggests that there may be something in the fact that the influx of air has not the velocity and current strength of the efflux, and states that the finding of Dr. Owens that air is not purified in its passage through the body appears to be proved without doubt by sillicosis in the Transvaal mines. He says:

> It takes very little time comparatively for a miner's lungs to fill up. He is then subject to all sorts of pulmonary diseases. Dr. Gorgas was summoned to see if he could offer anything to prevent or cure. Even when the men wear masks these do not entirely avail, as often the men are in close places and will not wear the masks.

Good water, sterilized milk and insect screens have aided materially in reducing disease. May we hope to add to the list filtered air? There seems to be no doubt but that the use of a mouth mask was helpful in combatting the spread of influenza.

ALEXANDER MCADIE

THE "PROCESSING" OF STRAW

IN a recent number of SCIENCE, Professor Harold Hibbert calls attention to the work done in Germany in converting straw into a feed of greater value by boiling it with soda and suggests that American farmers may convert a waste product into "a profitable and palatable cattle food of high nutritive value" by following the German example. Professor Hibbert has apparently overlooked the fact that this feed is extremely low in proteins. This fact was mentioned by Lorenz Hiltner in his pamphlet in 1917-18 and is recognized as being a point against "processed" straw as a feed. Various methods have been tried by the Germans to increase the protein content, some of which are mentioned by Hiltner.

The Office of Forage Crops has been interested in the development of this German work but has not been convinced of the value of the process for the American farmer. While it is not possible to make accurate estimates of the expense involved it is quite evident that the labor item would be considerable. The farmer would have to set up a plant however simple

whether he used the cold process with NaOH or the boiling process with soda. Such a plant would necessarily be of considerable size since straw is light and considerable quantities of liquid (eight times the weight of the straw) must be used. Besides the treatment, the processed straw must be washed to remove the alkali. All of this involves labor and increases the cost of the process. Besides it seems probable that in America it will always be possible to grow corn or sorghum for feed much more cheaply than to process straw even if the latter were wholly a waste material, which is not the case.

Without doubt the attention of experiment stations should be and probably has been called to this process but it seems unwise even to suggest it to the average farmer.

A. J. PIETERS

OFFICE OF FORAGE CROP INVESTIGATIONS,
U. S. DEPARTMENT OF AGRICULTURE

DOES THE BIBLE TEACH EVOLUTION?

THE creation of man according to the story in Genesis is placed by chronologists at about 4004 B.C. The acceptance of this date or indeed of any variation from it that has been suggested carries the imperative implication that all existing types of man—white, yellow, red, brown and black—Englishman, Japanese, Malay and Negrito—have all descended from Adam and Eve. It matters not what anthropological characters may be assumed for Adam and Eve, the diversity of their supposed progeny illustrates what the biologist means by evolution. The Biblical story with its logical implications stamps every believer in it as an evolutionist. However, no serious scientific man will admit for a moment that human evolution has proceeded as rapidly as the story in Genesis necessarily supports. Viewed from the evolutionist's standpoint, the theory involved in the Biblical story makes Darwin's ideas seem exceedingly conservative. Really Mr. Bryan ought to attack Darwin as a hide-bound reactionary whose notions regarding the slow rate of modification in species seriously challenges the truth of evolution as taught by the Bible.

CHARLES V. PIPER

SCIENTIFIC BOOKS

A History of the Whale Fisheries, from the Basque Fisheries of the Tenth Century to the Hunting of the Finner Whale at the Present Date. By J. T. Jenkins, D.Sc., Ph.D. London, H. F. and G. Witherby, 326 High Holborn, W. C., 1921. 336 pages, with reproductions from photographs and old engravings.

In the preface to this book, the author tells us that no attempt has hitherto been made to give within a brief compass a detailed history of the whale fisheries: to the best of our knowledge and belief, this statement is in the main correct and the volume under consideration may be looked upon as an effort to remedy this lack of information. Parts of the story have, it is true, been told, and told very well, particularly that relating to the United States, and these Mr. Jenkins has passed over somewhat lightly, devoting much time and care to bringing together and making available for the reader who knows only English the story of the early days of the fishery and especially the important part played by the Dutch who, having practically dispossessed the English, for more than a century successfully prosecuted the chase of the whale about Spitzbergen or, as it was constantly called, Greenland. At the height of this fishery, the decade from 1680-89, nearly 2,000 vessels sailed to Spitzbergen—1,966, to be exact—and the catch of whales was 9,487, but from that time, with certain spurts, the industry gradually declined, coming to an end about 1800.

Mr. Jenkins has been at great pains to give us the details of this whaling, the size of the vessels—often much larger than the average American whaler of the fifties—their crews, equipment, even provisions and the manner of capture and trying out. All of this is interesting and important, to most of us it is new, and for this information we are most grateful. In one detailed list of equipment is noted "150 hogsheads of cidar and four tunnes of wines, eight kintals of bacon and six hogsheads of beefe," proportions that might have met with the approval of Falstaff.

One point is surprising—the comparatively

small number of whales taken per vessel, the average being about three and seldom as many as five. To give an idea of the intensive, not to say destructive, methods of modern whaling, it may be noted that the day's catch of a steam whaler is often as great as the season's catch of these early days.

There were, however, some exceptionally "fat" years when the number ran up to ten or twenty whales per vessel, which possibly means better weather and better ice conditions.

The English in their first attempts did little better and it is small wonder that later on the Americans attained preeminence in their field, though they in turn failed sadly to realize the possibilities of modern steam whaling and the industry fell into the hands of the Norwegians. As practically the same weapons and methods were used by the Americans as by their predecessors and competitors, it would seem as if this success might justly be ascribed to the greater energy in the pursuit of whales.

The Americans seem to have had an inborn contempt for the use of any gun harpoon, for while it was employed by the English as early as 1780 in the capture of the Bowhead, it was never adopted by the Americans and it took a visit to South Georgia to convince the modern New Bedford whalers that the Norwegian whaling methods were really any improvement over their own. For that matter, even the English did not adopt their own gun harpoon until well along in the nineteenth century.

The English and Dutch did not have an entirely happy time owing to troubles with one another and with the French, and if a whaler secured a cargo of oil, it was by no means certain that he would reach home with it. In those days the line between privateering and piracy was none too sharply drawn and often the only rule followed was

> That they should take who have the power,
> And they should keep who can.

Spanish and French, Dutch and English, with some participation by Danes and Germans, Americans and Norwegians, each in turn led in the whale fishery and each has played, or is playing, an important part in the slaughter of the whale, and Mr. Jenkins tells us of them all.

The book opens with a chapter on Whales and their Classification, their habits and haunts, which is followed by one on the Economics of Whaling, including under this head the methods employed, utilization of products and the possibility of conservation. In discussing the measures that have been proposed or taken to preserve the whales, Mr. Jenkins seems inclined to give some credence to the argument of the whalers that the industry will in a way regulate itself, that long before whales can be exterminated, their capture—on account of lessened numbers—will cease to be profitable. This, as shown by experience in other "fisheries" and even by the collapse of Newfoundland whaling after a few years of prosperity, is a fallacy, as is the statement made in connection with the Natal whaling, and often used with all manner of statistics, that there is a tendency for the whales to abandon the coast altogether. Altogether is quite correct; as in the case of seals and walruses, the abandonment is due to the fact that the whales have been killed off and put beyond all hope of return. To illustrate, it may be said that Right Whales were formerly common off the eastern end of Long Island but that during the past decade only two have been seen and these fortunately escaped.

While steel and the automobile have temporarily stayed the extermination of the Bowhead since his "bone" is no longer in demand for whips and corsets, the species increases but slowly at the best and some new demand may blot the species out of existence.

So we subscribe most heartily to a previous statement, on page 47, that "in no case has the cessation of whaling taken place sufficiently soon to render possible the recovery of the whales to any appreciable extent."

About the only real protection that has been given whales is the prohibition, by the Norwegian government, of whaling in some localities and the establishment of close seasons in others. This has been done in response to the protests of fishermen whose reasons are set forth in the Last Phase of Whaling.

There is an occasional little slip here and there, as where it is said a superior kind of oil was found in the head of the Sperm Whale,

which might lead a careless reader to think that this was the sole source of Sperm Oil, even though in dealing with the Sperm Whale fishery it is apparent that this is not the case. Another statement capable of misinterpretation is that the "entire Arctic fleet was destroyed by pack ice in 1871," which happily was not the case, as, while 34 ships were crushed in the ice, seven vessels were left which brought home the crews without the loss of a single life.

In the very useful bibliography, we miss, among some others, any reference to Starbuck's "History of the American Whale Fishery" with its wealth of information and detailed lists of vessels and their catch. That the "Speckshioner" and his duties are not defined nor his title mentioned in the index is possibly a personal grievance due to "satiable curiosity" aroused by Kipling.

But these are trivial matters; destructive criticism is the easiest thing in the world, and to point out all the good things in the book would be to write another. Jenkins' "History of the Whale Fishery" is simply indispensable to any one interested in the subject of whaling, and in these days, when information in regard to the early days of the industry is eagerly sought for, and paintings, models and relics of the old whale ships bring surprisingly large prices, this book should be most welcome.

F. A. LUCAS
AMERICAN MUSEUM OF NATURAL HISTORY

SPECIAL ARTICLES

BACTERIAL PUSTULE OF SOY BEAN

EVER since 1904[1] there have been scattering references in phytopathological literature to a bacterial leaf spot or bacterial blight of soy bean, due, it was assumed, to *Bacterium phaseoli* Erw. Sm., but there has been no publication of any experimental proof of this theory. In 1917 Johnson and Coerper[2] published a note on a bacterial blight of soy bean caused by a white organism which in a later paper by Miss Coerper[3] was named *Bact. glycineum.* Since then Wolf[4, 5] and Shunk[5] have described a bacterial leaf spot caused by an organism which the former has named *Bacterium sojæ,* but which is very similar to if not identical with *Bact. glycineum* Coerper.

Since the publication of these papers there have been an increasing number of references in the literature, including the reports of the plant disease survey of the U. S. Department of Agriculture, to "bacterial blight" or "bacterial leaf spot" of soy bean without any mention of the causal organism, due to the assumption, presumably, that there is but one disease and that due to *Bact. glycineum* Coerper.

In 1917 the writer isolated from soy bean leaves from Texas a yellow organism very closely resembling *Bact. phaseoli* Erw. Sm. With pure culture inoculation with this organism infection has been repeatedly produced both on soy beans and several varieties of garden beans belonging to the genus *Phaseolus.* From these artificial infections the same yellow organism has been re-isolated and with it infections have been produced on sound plants. The infections on *Phaseolus* when made in favorable circumstances are not to be distinguished from those caused by *Bact. phaseoli* isolated from *Phaseolus,* but, except under very abnormal conditions to be described in a paper in preparation, no infections have ever been obtained on soy-bean with the latter organism, although repeated attempts have been made. Furthermore, there are certain internal markings very commonly though not universally present in the colonies of the soy-bean strain of the organism which have been observed in only two colonies of the many thousands isolated from *Phaseolus.* The markings

[1] Smith, Erwin F.: "Bacterial Leaf-spot Diseases," SCIENCE, N. S., XIX, No. 480, pp. 416-418, 1904.

[2] Johnson, A. G., and Coerper, Florence M.: "A Bacterial Blight of Soy Bean" (abstract), *Phytopathology,* VII, 65, 1917.

[3] Coerper, Florence M.: "Bacterial Blight of Soy Bean," *Jour. Agr. Res.,* XVIII, No. 4, pp. 179-193, 1919.

[4] Wolf, F. A.: "Bacterial Blight of Soy Bean," *Phytopathology,* X, No. 3, pp. 119-132, 1920.

[5] Shunk, I. V., and Wolf, F. A.: "Further Studies on Bacterial Blight of Soy Bean," *Phytopathology,* XI, No. 1, pp. 18-24, 1921.

have the appearance of central convolutions. They are wholly internal, the surface of the colony being smooth. Illustrations will be published in a later paper. The markings might be described in brief as a mottled, wrinkled (convolute) central area fading to a homogeneous margin, appearing in five to seven days and visible for one to two weeks. In view of these facts the writer, rightly or wrongly, has decided to name the soy bean organism *Bact. phaseoli* var. *sojense*.

The writer has never seen the *Bact. glycineum* blight in the field, but, judging from Miss Coerper's description and illustrations and her own greenhouse experiments the two diseases very closely resemble each other in the later stages. In the early stages, however, they are quite different, *Bact. glycineum* causing a water-soaking, a phenomenon never observed in the disease under consideration. *Bacterium phaseoli* var. *sojense* does, however, produce water-soaking in *Phaseolus*. Another difference—only noticeable in young infections is a slight raising of the center of the infected area in the case of infection with *Bact. phaseoli* var. *sojense*, hence the name "pustule." This raised portion may occur on one or both sides of the leaf and rarely, if ever, exceeds 1 mm. in diameter. It ultimately collapses or is sloughed off. Microscopic examination of these pustules shows both hypertrophy and hyperplasia. In the later stages the disease is characterized by angular reddish brown spots on the leaves, varying in size from tiny inconspicuous specks to large irregular brown areas involving a considerable portion of the leaf. Frequently the leaves have a ragged appearance due to the dropping out of portions of the large spots. A conspicuous though not universal accompaniment of this disease is a pronounced yellowing. The writer believes that in this stage only the isolation of the parasite could make possible a correct diagnosis of the disease, and it is in the hope of avoiding further confusion that this preliminary note is published. A paper covering the results of work since 1917 is in preparation. This disease occurs from Washington southward.

FLORENCE HEDGES
U. S. DEPARTMENT OF AGRICULTURE

THE AMERICAN CHEMICAL SOCIETY

(*Continued*)

DIVISION OF DYE CHEMISTRY

William J. Hale, chairman
R. Norris Shreve, *Chemistry*

The preparation of phenylglycine-o-carboxylic acid. I. From anthranilic acid and monochloracetic acid: HERBERT L. HALLER. A study of the preparation of phenylglycine-o-carboxylic acid from anthranilic acid and monochloracetic acid has been undertaken. Optimum conditions have been determined for (1) concentration in water of the reacting substances, (2) time allowed for reaction, (3) ratio of reacting materials, (4) condensing agent, and (5) temperature of reaction mixture.

On the preparation of 7-7' Di (α-hydroxyisopropyl) indigo: MAX PHILLIPS. Starting with p-cymene obtained from "sulphite turpentine" and using a modified procedure of the Heumann phenylglycine-o-carboxylic acid synthesis of indigo, a new indigoid dye has been prepared. The method used consists in first nitrating p-cymene, then oxidizing the nitro cymene to o-nitro p-hydroxyisopropyl benzoic acid; reducing this to o-amino p-hydroxyisopropyl benzoic acid; condensing the latter with monochloracetic acid to hydroxyisopropyl phenylglycine-o-carboxylic acid and finally fusing with potassium hydroxide. This new dye has a similar absorption spectrum to that of indigo and has quite similar dyeing properties.

A new method for the preparation of dicyanine and related dyes (By title): S. PALKIN.

The necessity for reclassification and standardization of dyes: C. R. DELONG and W. R. WATSON.

The influence of sulphur on colors of azo dyes: W. R. WALDRON and E. EMMET REID. Some 30 different bases containing sulfur in a variety of positions and associated with various alkyl and aryl radicals have been prepared, diazotized and coupled with representative dye intermediates to form dyes so as to show the influence of sulfur groups in various positions on the color. Bases having sulfur in the sulfide and sulfone condition have been compared with the sulfur-free bases, and it has been found that the sulfide sulfur is bathochromic while the sulfone group is usually hypsochromic.

Experiments with dehydrothio-p-toluidine and related compounds: MARSTON TAYLOR BOGERT and MARTIN MEYER. When dehydrothio-p-toluidine is subjected to Skraup reaction, it yields the corresponding benzothiazolyl quinoline. The Atophan

reaction was unsuccessful. Attempts to prepare dehydrothio-p-toluidine by fusion of nitro-toluene or of p-nitrobenzal-p-toluidine with sulfur gave very poor yields of the product sought. 2-p-tolyl-benzothiazole was prepared by the Jacobsen method from thio-p-tolanilide and some of its derivatives investigated.

Uses of p. toluenesulfonyl chlorine in the manufacture of dyes and intermediates: JULES BEBIE. p. Toluenesulfonyl chloride is a by-product in the manufacture of saccharin. A great amount of chemical work has been devoted to the utilization of this material and one of its derivatives, chloraminte-T, is generally known as an excellent germicide. Other derivatives have found application in the dye industry. The p. toluenesulfonyl chloride itself can be used in various ways in the manufacture of dyes and intermediates, particularly as a component or a part of a component for the production of various classes of azo dyes and in the combination with azo dyes containing hydroxyl groups with the purpose of making the resulting dyes fast for alkali and soap.

The method of determining the class to which each dye belongs: ANDREW J. LEDDY.

The function of assistants used in dyeing cotton: ANDREW J. LEDDY.

The application of the direct dyes in coloring paper: WALTER C. HOLMES.

The functions of the dye testing laboratory: R. E. ROSE.

The analysis of B. naphthylamine: HENRY R. LEE and D. O. JONES. Methods are presented for the analysis of B. naphthylamine in the presence of its common impurities, namely, B. naphthol, a-naphthylamine and B B dinaphthylamine. By sulfonation of B. naphthylamine the nitrate titration can be applied in the presence of B. naphthol. A separation of D. naphthylamine from B. naphthol and B B dinaphthylamine is made by precipitation of the former as the hydrochloride from benzol solution. The hydrochloride is dissolved in water and titrated with N/2 nitrite at 0-5° C. The benzol solution is evaporated to dryness and the B. naphthol determined by titration with diazo p-nitro-benzene. The Kjeldahl Gunning method has been modified by sulfonation of the sample with 25 per cent. oleum in the cold and the use of a glass wool plug in the neck of the flask during digestion. B. naphthylamine, a-naphthylamine, B. naphthol and B B dinaphthylamine were prepared in the pure state and some of their physical constants determined. Melting point curves are given for B. naphthylamine with each of these impurities up to 10 per cent.

DIVISION OF BIOLOGICAL CHEMISTRY

Howard B. Lewis, *chairman*

J. S. Hughes, *secretary*

Higher alcohols formed in the fermentation of sugar: J. C. SWENARTON and E. EMMET REID. Crude fusel oil, from the large scale fermentation of molasses with pure culture yeast, contains substances boiling above isoamyl alcohol even up to 270°. A quantity of the high boiling portion has been repeatedly fractioned in vacuum and the alcohol part of each fraction extracted by treatment with phthalic anhydride. The alcohols obtained by saponification of the mono-alkyl phthalates boil up to 110° at 8 mm. and vary in density at 25° from 0.8007 to 0.9067. Some are optically active. They are being studied further with the hope of identifying the individual alcohols. The non-alcohol portions of the fractions boil up to 155° at 10 mm. and have densities at 25° from 0.80 to 0.90. Some are optically active.

The toxic constituent of greasewood (Sarcobatus vermiculatus): JAMES F. COUCH. Greasewood is an important forage plant for sheep on the winter ranges in the west. It is common in the semi-arid alkali valleys of the far western states, and, while it is extensively grazed, it has been found by Marsh, Clawson and Couch to be poisonous. Chemical examination of the edible portions of the plant showed that they contain a large proportion of oxalic acid and unusually large amounts of sodium and potassium salts. Toxic alkaloids, glucosides and saponins were absent, and it was shown by experiments upon sheep that the poisoning is due to sodium and potassium oxalates. The leaves of the plant contain the largest proportion both of ash and of oxalic acid; in the stems most of the oxalic acid is combined as calcium oxalate.

Influence of breeding upon oil and protein content of cotton seed: C. L. HARE.

The iodine absorption of urine: JACK MONTGOMERY.

Influence of sodium chloride upon animal excretion: E. R. MILLER.

Further experiments on the isolation of vitamin: ATHERTON SEIDELL. The method as now used for the preparation of highly active vitamin fractions consists in heating fresh brewer's yeast mixed with water to about 90° C.; adsorbing the vitamin present in the filtered solution by means of English fuller's earth; extracting this latter with saturated barium hydroxide solution; and concentrating the extract, after acidifying with sulfuric acid and filtering, by rapid vacuum distillation. More detailed experiments on the precipitation of the vitamin in these concentrated extracts by

means of silver salts have shown that approximately one third of the solids present unite with the silver salts to form insoluble silver compounds. About one half of the total vitamin, as determined by feeding experiments on pigeons, is present in these insoluble silver precipitates and the other half remains in the filtrate. This unexpectedly large unprecipitable fraction of the vitamin raises the suspicion that the portion accompanying the silver precipitates may not be in chemical combination but simply held by adsorption. Further studies of the silver precipitates and filtrates are in progress.

Cow's milk versus goat's milk as a source of the antiscorbutic vitamin: C. H. HUNT and A. R. WINTER. Four weeks before the experiment started two cows and three goats were placed on the same ration, consisting of equal parts of a grain mixture and alfalfa hay. Forty-four guinea pigs were divided into eleven lots of four each and were given a weighed daily amount of a basal ration consisting of rolled oats 69 parts, autoclaved alfalfa flour 25 parts, casein 5 parts and NaCl 1 part. All of the pigs received, with the exception of the control lot, in addition to the basal diet, a measured amount of milk each day; one half of the lots receiving cow's milk and the other half goat's milk. The amount of milk fed varied from 10-50 cc in increments of 10 cc. The control lot died of scurvy in 26-30 days. The pigs receiving 10 cc. of cow's milk survived from 42-53 days, while the survival period of those receiving 10 cc goat's milk was from 60-103 days. Up to a period of 90 days one death from scurvy occurred among the lot receiving 20 cc. cow's milk, while no deaths from scurvy occurred among the pigs receiving 20 cc. goat's milk. There was a decline in weight of both lots receiving 20 cc. milk, but the decline was greater with those receiving cow's milk than with those receiving goat's milk. When the amount of milk fed daily was increased to 30 cc. or more no difference was noted between cow's and goat's milk as a source of the antiscorbutic vitamin (C).

Results obtained by feeding breeding gilts a ration low in vitamin: J. S. HUGHES and H. B. WINCHESTER. Breeding gilts receiving a feed low in vitamin A and C developed no abnormalities during the first ten months. At this time they developed the eye trouble common to rats, rabbits, dogs and other experimental animals, and in addition to this they developed a nervous disorder manifested by a general incoordination accompanied by frequent convulsions. Two of the eight did not breed, two died during the latter part of the gestation period, two aborted a few days before they died, one farrowed dead pigs and the last one went fourteen days longer than the normal gestation period. Gilts receiving 5 per cent. alfalfa as a source of their vitamin A showed no abnormalities. Five per cent. alfalfa did not furnish sufficient vitamin for normal reproduction, as 28 per cent. of the pigs farrowed by these sows were dead.

Influence of the vitamin content of a feed on immunity to roup: J. S. HUGHES, L. D. BUSHNELL and L. F. PAYNE. Chickens receiving a feed low in vitamin were much more susceptible to roup than those receiving a similar feed high in vitamins. Four pens, of twelve chickens each, received feeds varying in their vitamin content. One chicken from the pen receiving a feed high in vitamins, eight from the pen receiving a feed low in the fat-soluble vitamin, seven from the pen receiving a feed low in the water-soluble vitamin and nine from the pen receiving a feed low in both fat and water-soluble vitamin, died with clinical symptoms of roup or a disease similar to roup. All chickens were exposed to the roup infection by keeping infected chickens in the pens.

The detection and estimation of inorganic activators in commercial rennin and pepsin preparations: HARPER F. ZOLLER. An activator-free pepsin or rennin solution coagulates dialyzed milk with great difficulty at the optimum temperature (41° C.) for rennin action. The presence of calcium or magnesium ions accelerates the enzyme action and gives the coagulum its normal physical consistency. The differential between the rate of coagulation in dialyzed milk and in undialyzed milk furnishes a factor, which when compared with a similar factor obtained from activator-free enzyme solution under the same set of conditions, furnishes a means of roughly estimating the quantity of activator or accelerator present.

A laboratory disinfectant solution to displace mercuric chloride: HARPER F. ZOLLER. Sodium hypochloride solution furnishes a means of providing an efficient, economical and safe sterilizing agent for use in biological laboratories. In the preparation of the solution it is essential to maintain a sufficiently high hydroxyl ion concentration for maximum stability—about p_H 10.5. Solution containing about 0.15 per cent. available chlorine (0.32 per cent. sodium hypochlorite) will destroy the most persistent of micro-organisms within ten minutes.

The decomposition of food by bacillus botulinus: I. K. PHELPS and J. E. BASCH.

The feeding of non-ketogenic odd-carbon fats

to diabetic patients: MAX KAHN. It is prohibitive to feed diabetic patients who have a very low carbohydrate tolerance even a moderate amount of natural fat because of the danger of inducting a severe ketosis which may prove fatal. It was found that synthetic non-ketogenic odd-carbon fats could be fed in large quantities to such persons without inducing any acidosis, and that the nutrition of such individuals was improved. A study is now being made of the intermediate metabolism of these fats and their effect on all types of diabetic and normal individuals.

A new source of santonin: ARNO VIEHOEVER and RUTH G. CAPEN. As a result of a survey of American plants it is evident that santonin can be obtained from *Artemisia mexicana* and *Artemisia neo-mexicana,* which grow wild in Mexico, New Mexico and neighboring states. The survey thus far made comprises 17 species and plant material obtained from 30 different sources. The santonin isolated was identified by the form and refractive indexes of the crystals, the melting point, furfural reaction and the formation of santonin periodide. Though no quantitative data are as yet on hand, the manufacture of santonin, now quoted at $150 per pound, from domestic sources appears a distinct possibility. (Contribution from the Pharmacognosy Laboratory, Bureau of Chemistry, Department of Agriculture).

A new method for the colorimetric determination of Peroxidase: VICTOR E. LEVINE. The leuco base of malachite green is used as the reagent. In the presence of peroxidase this compound turns emerald green on the addition of a small quantity of hydrogen peroxide. Proteins of the enzyme extract are coagulated by chloroform, which also dissolves out the green dye. On centrifuging the mixture separates into a green chloroform layer on the bottom and a colorless layer on top. Between these two layers is a zone of coagulated protein. The chloroform solution is separated from the other layer and is made up to volume. The removal of the proteins renders the extract clear for colorimetric examination. The standard is a solution of malachite green in chloroform. It must be made up fresh as it has a tendency to deteriorate on standing.

A simple method for differentiating boiled or pasteurized milk from unboiled or unpasteurized milk; Selenium compounds as biochemical reagents: VICTOR E. LEVINE.

The catalytic properties of the metals occurring in respiratory pigments: VICTOR E. LEVINE and ARTHUR C. ANTONY.

DIVISION OF SUGAR CHEMISTRY

S. J. Osborn, *chairman*
Frederick Bates, *secretary*

The moisture absorptive power of different sugars and carbohydrates: C. A. BROWNE. Comparisons were made of the water absorptive power of anhydrous dextrose, levulose, rhamnose, sucrose, maltose, lactose, raffinose, starch, cellulose, mannite, invert sugar, honey, molasses, malt syrup, commercial glucose and agar under different conditions of atmospheric humidity. The substances of greatest absorptive power at end of one hour exposure (at 20° C., 60 per cent. rel. humidity) were starch (1.04 per cent), cellulose (0.89 per cent.), agar (0.88 per cent.), and of least absorptive power dextrose (0.07 per cent.), mannite (0.06 per cent.), sucrose (0.04 per cent.). At the end of nine days' exposure the substances of greatest absorptive power were agar (20.34 per cent.), starch (12.98 per cent.), raffinose (12.90 per cent.), and of least absorptive power dextrose (0.07 per cent.), mannite (0.05 per cent.), sucrose (0.03 per cent). At the end of 25 days' exposure at 20° C. and 100 per cent. humidity the substances of highest absorptive power were invert sugar (76.58 per cent.), honey (74.10 per cent.), levulose (73.39 per cent.), and of lowest absorptive power cellulose (12.57 per cent.), lactose (1.38 per cent.), mannite (0.42 per cent.). The presence of levulose increases water absorptive power, but the latter is not proportional to the levulose content. The absorptive power of the substances was lowest in February and highest in July and August. The natural fluctuation noted from some substances were: levulose, 11.19-36.31; invert sugar, 11.81-34.73; agar, 21.00-30.74; starch, 12.29-18.41; cellulose, 5.06-10.89; maltose, 5.46-9.37; mannite, 0.22-0.52. The general tendency of sugars is to absorb moisture up to the amount necessary to form a stable hydrate form.

Sugar purity determinations: W. D. HORNE. Great numbers of sugar purity determinations having to be made daily for chemical control of sugar factories and refineries, a very rapid and accurate method has been evolved, by means of special appliances. A Brix spindle containing a complete temperature correction scale gives a correct Brix for any density and temperature. Defecation with "dry lead" is practically instantaneous and more accurate than by the use of lead solution. From the Brix and the polarization thus obtained, one finds the purity on a table of purities printed on a long paper mounted on movable rolls easily exposing the desired portion.

Plastometer tests on alkaline thin boiling corn starches: C. E. G. PORST and M. MOSKOWITZ. Corn starches of various fluidities ranging from ten to fifty (as determined by the Corn Products Refining Company's funnel method) were prepared having alkalinities varying between acid to phenolphthalein up to .12 per cent. alkali. The pastes from these starches were then tested on the plastometer. Results show that the paste from starches which were just about neutral to phenolphthalein were firmer than those that reacted acid. As the alkalinity of the starch increased, the pastes became smoother and more elastic. Methods for preparing the pastes were standardized and made uniform. Two concentrations of starch pastes were used in the tests. Curves were plotted in the regular manner, and also on logarithmic paper. The equation for the flow in cubic centimeters per second in terms of a function of the pressure was determined from the logarithmic curve.

The determination of gums in sugar products: H. T. RUFF and J. R. WITHROW. The various analytical methods proposed for gum determination in sugar products were studied and compared for the purpose of determining the method best adapted for control work. Some proposed methods compared with each other on solutions of pure gums in water or refined sugar solutions, but were not comparable on customary sugar products. The method of precipitating the gums with ethyl alcohol acidified with hydrochloric acid was found to be the most suitable and was further studied to determine concentrations of alcohol and acid. While we have no claim to originality in method adopted, the technique is original and is definitely expressed to make results obtained rapid and reliable. It was found with certain precautions denatured or wood alcohol could substitute for ethyl alcohol. Curves are plotted to show the influence of concentration of alcohol and acid.

The determination of the p_H value of commercial glucose as a substitute for the candy test: O. A. SJOSTROM.

Some notes on the determination of reducing sugars: B. B. ROSS.

An improved precision refractometer for the sugar industry: WARREN P. VALENTINE. This paper contains a short reference to the development of the refractometer and its increasing application in the sugar industry; errors and approximations in the present sugar tables and the consequent demand for highly standardized data; the construction and test by the Bureau of Standards on a special refractometer, and the final development of an instrument to utilize new sugar tables now in process by the Bureau of Standards.

The observance of mutarotation in the polarization of raw cane sugar: M. H. WILEY and C. A. BROWNE. In the polarization of two deteriorated sugars from the Cuban crop of 1921, the direct polarization immediately after solution decreased at the end of three hours in one instance from 90.85 to 90.15 and in another instance from 90.15 to 89.50. The sugars had undergone considerable inversion during storage from the attack of micro-organisms, and the mutarotation is probably due to the very perceptible drying out of the sugar in the bags and the separation of the high rotating modification of dextrose in the sirupy films which cover the crystals of sucrose.

Note on the color range of cane sirups and molasses: F. W. ZERBAN. Dr. Zerban reported an interesting series of color measurements on cane syrups made according to the Bureau of Standards method with two simplifications, both of which are objectionable—the use of Kieselguhr to obtain an optically pure filtrate and the use of the Hess-Ives instrument with white light. The color values showed a general correlation with the purity.

Manufacture of plantation standard granulated sugar with and without activated char: C. E. COATES. An outline is given of the various methods for making standard granulated sugar in the sugar house, including: Its manufacture direct from the cane without the use of char, using sulfitation or carbonation of the juice; the non-chemical process using heat and Kieselguhr, the clear juice being given immediately a char filtration; making carbonated or sulfited syrup, which syrup is subjected directly by a char filtration; the manufacture of 96 test sugar as usual and immediately remelting and treating the melted sugars with char. Much improvement has been made during the last few years, both in quality of product and in yield.

The decolorizing power of bone char (preliminary report): PAUL M. HORTON. It has been claimed by Patterson that the decolorizing power of boneblack is due to a nitrogenous base which can be extracted by concentrated sulfuric acid. Patterson's experiments have been repeated, the results leading to the conclusion that the nitrogenous base mentioned has no special decolorizing power, and that the decolorizing power of boneblack must be due to other causes. The extract

was made with both warm and cold sulfuric acid and the acid removed by dialysis, leaving the acid-free base in a form suitable for testing its decolorizing power.

Color and ash absorption by boneblack and decolorizing carbons: W. D. HORNE. While a number of very good decolorizing carbons have been developed, they generally lack the power to absorb ash, which is of great importance in sugar refining. Experiments show that it is the mineral frame-work in boneblack which absorbs most of the ash taken up by boneblack. Calculation shows that a carbon deficient in ash absorbing power could scarcely compete economically with boneblack in refining. Encouraging results in ash as well as color absorption were had with an artificial boneblack formed by the fixation of carbon on a porous earthy substratum. The attention of investigators is invited in this direction.

Control of reaction in sugar house (and refinery) liquors: J. F. BBEWSTER and W. G. RAINES, JR. No matter what clarifying agent was used, in the clarification of cane juice, there always was obtained upon concentration to sirup a precipitate changing in quantity and composition according to the cleanness of the cane and the method of clarification.

The precipitate formed in sugar house sirups: J. F. BREWSTER and W. G. RAINES, JR.

Modifications in the use and application of the Hess-Ives tint photometer: H. H. PETERS and F. P. PHELPS. In addition to the Hess-Ives color plate, various Wratten light filters were used in connection with white light. It is pointed out that special lamps (for instance, a mercury vapor lamp in place of white light) may advantageously be employed with special light filters in place of the Hess-Ives three fundamental colors (red, green and blue), for instance, mercury yellow, green and violet. One then obtains scale readings (per cent. transmittancy), which, interpreted as negative logarithms, refer to definite wave-lengths instead of to broad spectral bands. The color values of the Hess-Ives plate and of several Wratten filters are plotted as transmittancies and luminosities, which were also given for Stammer standard color plates, Stammer's ulmine solution and various sugar products. Their absorption graphs are given also. The authors use the subject of tint photometric analysis as introduction to their spectrophotometric investigations. In three of the papers given so far, the chemical aspect of color analysis was discussed, while here the optical aspect is treated in detail. Hundreds of quantitative spectrophotometric analyses of sugar products have proven conclusively that the absorption and transmittancy in the blue end of the spectrum is of paramount importance.

Color values of high grade sugars: W. B. NEWKIRK and H. H. PETERS. The absorption and transmittancies of 204 high class sugars were determined for yellow, green and violet mercury light, using a Stammer colorimeter which had been modified in such a manner that it was practically a spectrophotometer. The Stammer color plate was entirely dispensed with, and a rotating sector disc used in its place. The average results of various classes of sugars are plotted in various ways.

A laboratory vacuum still: E. P. CLARK. A laboratory vacuum still is described which is of a simple type of construction and is compact and easily dismantled. The capacity is quite large (12 liters), concentration taking place in glass. An ordinary laboratory water pump furnishes sufficient vacuum.

Preparation of adonitol: R. S. BLACK. Crystalline adonitol is prepared by extracting adonis vernalis plants with hot water, defecating the expressed liquid by first adding aluminum sulfate solution followed by an excess of slacked lime until precipitation is complete. The yellow precipitate is removed by fitering upon a suction filter. Concentrate the filtrate in vacuum to a thin sirup when basic lead acetate is added, filter, remove the excess lead, concentrate to a sirup and add alcohol. At this point a little phosphoric acid added to the alcoholic solution throws out more impurities and aids in the subsequent crystallization. The alcoholic solution is evaporated to a thick sirup and taken up in an equal volume of 95 per cent. alcohol, is seeded and is allowed to crystallize. Recrystallize from 95 per cent. alcohol.

DIVISION OF INDUSTRIAL AND ENGINEERING CHEMISTRY

W. K. Lewis, *chairman*
E. M. Billings, *acting secretary*

Symposium on Distillation

W. A. Peters, Jr., chairman

Efficiency and capacity of fractionating columns: W. A. PETERS, JR. The efficiency of plate columns and columns filled with spheres and cylinders of various sizes was measured by comparing the performance of each with the calculated performance of a theoretically perfect col-

umn. The capacity of the different types of columns was determined by measuring the maximum possible heat input or vapor velocity through the column when various materials were being separated. Both efficiency and capacity were found to vary widely with the type and size of filling and with the materials being separated. From the data determined, it is possible to figure the size and cost of a fractionating column of any type for almost any work. Moreover, it is possible to set up in the laboratory a small column which will duplicate the performance of any plant sized column. Thus, a fractionating problem can be worked out in laboratory apparatus and from the laboratory data a plant sized column can be designed.

The plate efficiency of a continuous alcohol still: CLARK S. ROBINSON. Three tests on a continuous alcohol still under varying conditions indicated average plate efficiency of from 24 per cent. to 56 per cent.

The simple distillation of hydrocarbon mixtures: W. K. LEWIS and CLARK S. ROBINSON. It is possible to predict the simple (Engler) distillation curve (boiling temperature plotted against percentage distilled over), for mixtures of two or more components which follow Raoult's Law approximately. This is of great importance in the petroleum industry and in the recovery of the benzene homologues from the destructive distillation of coal. The application to binary mixtures is simple, but when applied to complex mixtures, the problem must be solved graphically. The Engler curve is calculated for benzene-toluene mixtures and is compared with the experimental curve.

Benzol purification: S. S. HEIDE. The custom has been as outlined in making C. P. products to make separate crude cuts of light oil, such as 90 per cent. benzol, 90 per cent. toluol and crude light solvents and treating these separately with sulfuric acid. With this procedure the benzol fraction is somewhat difficult to wash down to proper color test, due to nature of acid sludge produced by action of sulfuric acid. The toluol fraction gives no trouble, good clean separation being obtained. One point brought out is that C. P. benzol will have lower color test than sample taken from agitator subsequent to acid treatment. Just the reverse is true in operation using 90 per cent. crude benzol fraction.

Wood turpentine: C. A. LAMBERT. A brief outline of the factory method for the manufacture of steam distilled wood turpentine, the approximate composition and the physical chemical characteristics of the turpentine and of the heavier fractions of the turpentine known as pine oil.

The calculation of the heats of vaporization of various liquids, first by means of the Hindebrandt function; second, from vapor pressure curves: W. K. LEWIS and H. C. WEBER... This is a short article dealing with an original method of using the molal entropy of vaporization of liquids for determining their heats of vaporization of various vapor compositions, together with a method for determining heats of vaporization from vapor pressure curves.

Present practice of dynamite and chemically pure glycerine distillation: J. W. BODMAN. It is shown that the most recent glycerine distillation plants use the principle of double effect evaporation in that the superheated water vapors used as a distilling agent for the glycerine receive superheat from the latent heat of condensation of the glycerine distilled. While the apparatus illustrated and described for distilling dynamite glycerine has thus far been used in the comparatively restricted field of glycerine distillation, the same principle is well adapted for use in connection with any liquids which show a tendency to partially decompose when distilled directly or alone at normal pressure.

Turpentine distillation: MCGARVEY CLINE.

Carburetor adjustment by gas analysis: A. C. FIELDNER and G. W. JONES. Road tests on motor vehicles has shown that approximately 30 per cent. of the heat value of the gasoline is lost due to incomplete combustion products in the exhaust gas. At least 50 per cent. of this loss can be saved by proper carburetor adjustment. Curves are given showing how the CO_2 per cent. in the exhaust gas bears a direct relation to the mileage and completeness of combustion from the gasoline used. Tests are given showing proper method of sampling exhaust gases and procedure for adjusting a carburetor on the road. A portable CO_2 indicator for adjusting carburetor is described and examples given showing increase in mileage obtained with increase in the CO_2 percentage in the exhaust gas.

Investigations of whitewashes and aqueous lime paints: G. J. FINK. Results are given on the development of whitewashes and aqueous lime paints which involved exposure tests of 175 formulas. The effects of a large number of ingredients in various combinations are shown and conclusions given regarding the relative merits of the various formulas. Of the siccatives used those as casein forming insoluble films with

lime proved best, while those which are water soluble as glues are not so satisfactory for exteriors. Several alkaline salts were used for accelerating the solution of casein, trisodium phosphate proving most satisfactory. Among the addition agents used with lime in mixtures containing no definite siccative alum and table salt were effective on improving the workability and permanence of the whitewashes. Several formulas developed and tested are shown to be superior to most of those in common use.

Can we afford to make potash in America? R. NORRIS SHREVE. Broad economics regarding the manufacture of potassium salts in America and from American raw materials are considered. Cost of materials, labor and freight is discussed and the value of various by-products cheapening the cost of the primary material is treated. Is it worth America's while to pay the cost necessary to finish the development of the potash industry? Past, present and probably future costs to farmers and chemical industry for their potash are described. It will be money in the pockets of American potash consumers to build their own industry here, but the potash industry should be developed regardless of cost for it is necessary to safeguard food and clothing of the country.

Discontinuous extraction processes: L. F. HAWLEY. This paper is a study of Turrentine's extraction process[1] according to the theory of discontinuous extraction formerly developed.[2] By using Turrentine's data in the mathematical theory of the process it is shown that the incomplete extraction is due to the fact that complete solution of the potassium chloride was not obtained in the first treatment of the raw material. The other conditions of extraction were so efficient that the final recovery was only slightly less than the theoretically perfect recovery with the solvent ratio and number of treatments employed in the process.

The classification of coal: S. W. PARR. The use of ratios between certain constituents as an index of coal types shows that the value of a ratio depends upon the freedom of the factors employed from adventitious material, or material not essential in producing the type characteristics to be indicated, and shows that the use of analytical factors in the construction of a system of classification based on ratios is limited, for the ratios do not differentiate with respect to variables inherent in the actual coal substance as oxygen. This factor is significant as between different types, and its effect should be given a place in any system indicating type distinction. Such a factor may enter into the scheme of classification by using heat values referred to the unit or pure coal substance. Accuracy of the values derived from the author's unit coal formula are shown.

A comparison of the standard gas furnace and micropyrometer methods for determining the fusibility of coal ash: A. C. FIELDNER, W. A. SELVIG and W. L. PARKER. The micropyrometer method for determining coal ash fusibility is quicker than the gas furnace method and better for the operator. Coal ashes fusing under 2,600° F. by the gas furnace method can usually be checked within 100° F. by the micropyrometer method if fused in a reducing atmosphere of combustion gases similar to that employed in the gas furnace method. Very refractory ashes, fusing above 2,800° F. as determined by the gas furnace method, tend to give considerably lower results by the micropyrometer method. The two methods can not therefore be considered as strictly alternate methods for all ashes. The great majority of coal ashes from American coals, however, fuse below 2,800° F. in the gas furnace.

The calorific value of American woods: S. W. PARR and C. N. DAVIDSON. There are no well authenticated values published in the literature for the calorific value of American woods, and the published values for foreign woods are unreliable. The values of the time of Berthier and Winkler are about 50 per cent. of those reported by Gottlieb, yet no basis of fair comparison is possible because of the lack of definite information as to the presence of moisture. The paper reports on a detailed study of the moisture factor in order to base calorific values upon the moisture-free material. The heat values were determined by means of a calorimeter, adiabatic in type, using a bomb with platinum lining.

The shatter and friability tests for metallurgical coke: S. P. KINNEY and G. ST. J. PERROTT. A discussion of testing methods, reproducibility of results, and their interpretation. A large amount of test data obtained at the Southern Experiment Station of the Bureau of Mines is used as the basis of the discussion. A comparison of results of the machine and bag shatter test procedure, an improved method of conducting the bag shatter test, the effect of size of coke on absolute and relative results obtained by the friability or "hardness" test, and the effect of other modifications of the standard procedure are given.

[1] *Jour. Ind. and Eng. Chem., 13,* 605 (1921).

[2] Discontinuous Extraction Processes, *9,* 866 (1917).